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DOCTRINA VIM PROMOVET INSITAM

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*References:*

Raman, C. V. (1949) The theory of the Christiansen experiment. *Proc. Indian Acad. Sci.*, A, 29: 381-90.

Sahni, B. (1936a) Wegener's theory of continental drift in the light of Palaeobotanical evidence. *J. Indian bot. Soc.*, 15: 31-32.

Sahni, B. (1936b) The Karewas of Kashmir. *Curr. Sci.*, 5: 10-16.

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# On the Hypersthene—Bearing-Rocks of Salem—II

BY

S. RAMANATHAN
*Department of Geology and Geophysics,*
*University of Madras, Madras-25*

(Continued from p. 159, *J. Madras Univ., B*, XXVI, No. 1)

## V. *Variegated Gneisses*

The variegated gneisses form the main rock type to the west of the intermediate charnockites of Shervaroys and Jarugamalai. They are mostly migmatitic in character with the salic portions traversing across the foliation planes of the mafics. The mafics have a tendency to occur in basic clots both in the field and in thin sections. There are also small lenticles of garnet-pyroxene rocks occurring in the biotite-gneisses, e.g., near the Magnesite Syndicate Ltd., near Karuppur and near Omalur. There are also small lenses of garnetiferous granulites containing hypersthene, occurring in the variegated gneisses, e.g. near Karuppur.

These gneisses can be divided essentially into four types.

1. Phyllites.
2. Biotite-gneisses (a) Containing green biotite
   (b) Containing brown biotite.
3. Hornblende-gneiss.
4. Amphibole-biotite-Scapolite-gneiss.

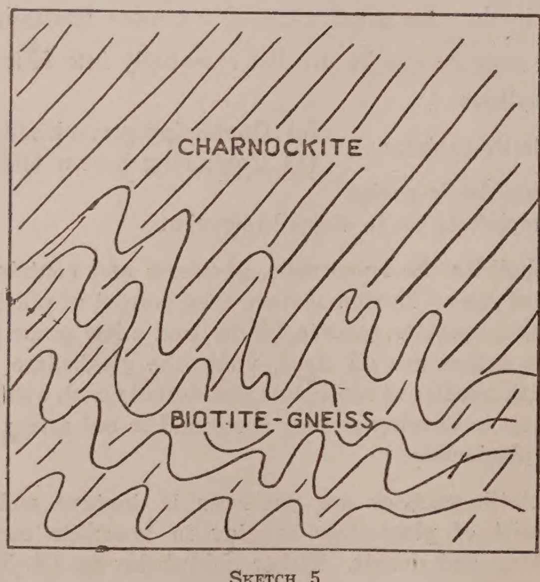
The phyllites are leucocratic, gneissose and contain cleavable fragments of mica. In thin section, they consist of plagioclase and quartz, with muscovite, sericite, biotite, and a few grains of epidote. The quartz grains are all clear, while the plagioclase grains are clouded with needles of muscovite and sericite with epidote. These are the latest to develop as they are found to cut across the lamellae of the plagioclase.

The biotite-gneisses are gneissose in texture and the salic bands consist of plagioclase ranging in anorthite content from $An_{20}$ to $An_{25}$ and quartz. Either reddish brown (S. 54) or dark green (S. 83, R. 27) mica forms the mafic layer with a little hornblende and magnetite. The plagioclase grains are clouded with needles of sericite. The biotite grains occur in tufts and clots

showing their migmatitic origin. The gneisses containing green biotite also have a little calcite and epidote occurring with the tufts of biotite.

The next group, the hornblende-gneiss, is dark in colour and the texture is xenomorphic, granular with a crude gneissose banding. It consists of plagioclase altering to kaolin along the lamellae, and hornblende mostly chloritised. The hornblende grains are surrounded almost invariably by a rim of blue-green hornblende and also veins of this mineral are found to trespass the lamellae of the plagioclase. A little iron-ore and apatite are the accessories with a few grains of sericite.

The amphibole-biotite-scapolite-gneisses occur with the basic granulite, R. 28, which also contains scapolite, and is traced nowhere else. The rock consists of plagioclase, Quartz, blue-green hornblende, green hornblende, scapolite and biotite with plenty of apatite. A little iron-ore forms the accessory. Portions of most scapolite grains are disintegrated into plagioclase, blue-green hornblende and calcite. Most of the scapolite grains have a rim of carbon. The scapolite has perfect (001) cleavage. The green amphibole is poikilitic with scapolite and clear plagioclase.




SKETCH 5
The foliation plane of the biotite-gneiss is twisted into contortions at the junction of intermediate charnockites.

The variegated gneisses on the Salem-Namakkal road are intimately mixed with intermediate charnockites of Jarugamalai. There are lenses of the biotite-gneisses occurring in the charnockites. The two imperceptibly mix with each other and in such cases, the foliation is clearly visible in the biotite-gneisses and is very poorly developed in the intermediate charnockites. In some places, the foliation plane of the biotite-gneiss is twisted into contortions at the junction of intermediate charnockites (sketch 5).

## VI. *Intermediate Charnockites*

The intermediate charnockites are the rock types that give the conspicuous topography of the Shervaroys and Jarugamalai. They are also found as discontinuous bands and lenses lower down in the Nagaramalai, Kusamalai and adjoining places. Holland (1900) has remarked that "even in a hand specimen, the composite nature of these intermediate rocks is generally very noticeable, the basic and acid portions being either distributed in irregular patches or arranged in parallel bands". Howie (1955), however, states that this has not been observed in the specimens examined by him. The author has found a general occurrence of irregular patches and bands of basic and acid portions. In specimens which show foliation, the banding is due to the enrichment of the salic minerals in streaks. In several places, intermediate charnockites are found grading into leucocratic rocks, almost devoid of mafic minerals. Similar phenomenon has been noted in Varberg district by Quensel (1951).

The intermediate charnockites of this area may be divided conveniently under two groups.

1. Those occurring in Shervaroys and Jarugamalai. All these are characterized by clear grains of felspar. Both felspar and quartz are crushed to various sizes.

2. Those occurring in other places, at the lower level, as discontinuous bands and lenticles. The felspars in this are all clouded while quartz is clear. These rocks are also crushed, but not to the extent seen in Shervaroys and Jarugamalai.

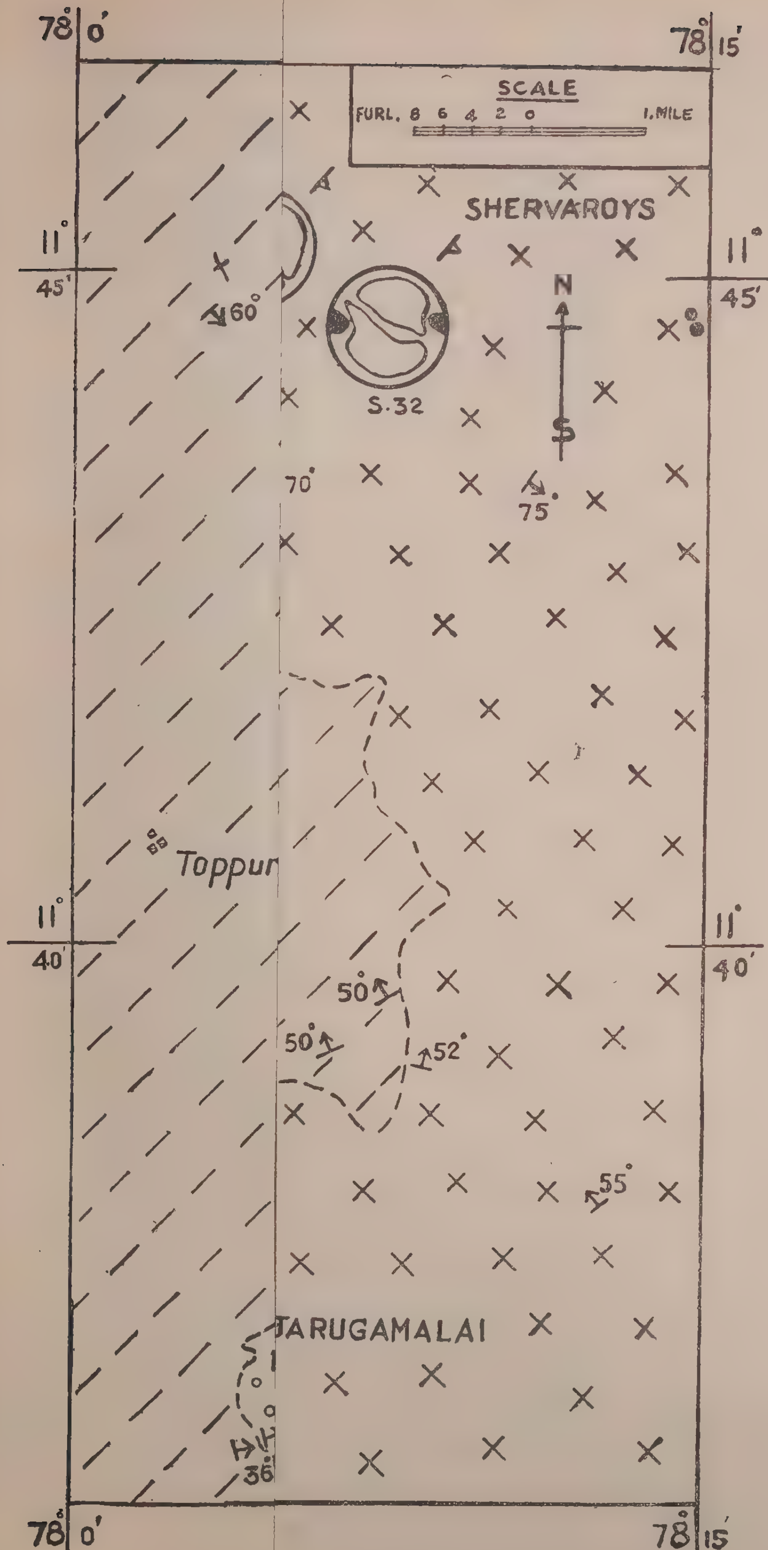
*Group* I. The clear felspars and quartz exhibit good crushing and milling, the sizes ranging from 2 mm, to minutely powdered

grains (·05 mm). In some cases, the hypersthene grains are crushed to pieces, while in others, they are found crushed and drawn into stringers. The elongation ratio of these minerals is (2mm $\times$ ·2mm).

The occurrence of mafics in irregular patches is clearly seen in thin sections. In this respect, they differ remarkably from the basic granulites. Often in the same section, a portion consists merely of crushed quartz and felspar with iron-ore and a little apatite, recalling the leptites associated with magnetite-quartz rocks; while, the other portion consists of clots of the mafics with quartz and felspar.

This group may again be subdivided depending on the mineralogical composition into the following types.

The rocks that are found at the top of Shervaroys and Jarugamalai (G. 52, G. 53, S. 67, S. 68 etc.), are medium grained, granulitic in texture, with all the minerals showing anhedral outlines. It consists of plagioclase, antiperthite, quartz, hypersthene, diopside and hornblende. The plagioclase shows fine twinning lamellae, or is untwinned, the anorthite content ranging from $An_{20}$ to $An_{35}$. Some grains are strongly antiperthitic. The An. content of the hosts of antiperthites also ranges from $An_{25}$ to $An_{35}$. In a majority of cases, the antiperthitic inclusions are long and rod-like parallel to (010) and appear as blebs on (001). In some cases, there were two sets of spindles observed, intersecting each other at 90° on the (100) face. In such cases, one set of spindles is parallel to (010), when they appear as long rods, while the other set is parallel to (001). The optics of the inclusions could not be determined fully; but the optic axial angles of the spindles in a few grains were measured and they are $-2V \doteq 73°, 70°, 60°, 60°, 58°, 56°$ and 48°, on seven grains. There were also a few grains of potash felspar occurring individually with an optic axial angle $-2V = 70°-74°$. The same observations on the antiperthites of Salem have been made by Naidu (1955) and he gives the values of optic axial angle for the spindles as $-2V = 40°, 46°, 60°, 74°$ and 83° and $(n_\gamma - n_\beta) = \cdot 0008$ and $(n_\gamma - n_\alpha) = \cdot 0052$. Howie (1955) is of opinion, that the potash felspars with $-2V = 62° - 74°$, and showing wavy extinction suggest a variety between microcline and orthoclase, basing his evidence on X-ray studies. The quartz is clear but have occasionally needle-like inclusions arranged in definite orientations. (Holland, 1900).




fabric determined.
Pyroxenite.

The hypersthene and diopside grains are also crushed. Their optical characters are given below.

Hypersthene:

$$-2V = 58° - 60° \quad \gamma - \alpha = \cdot011 - \cdot012. \quad \gamma - \beta = \cdot003 - \cdot004.$$
$$\beta = 1\cdot704.$$

X = Light pink. Y = colourless. Z = light green.

Diopside:

$$+2V = 57° - 58° \quad \gamma - \alpha = \cdot021 - \cdot023$$
$$Z \wedge C \ 39° - 41° \quad \gamma - \beta = \cdot018 - \cdot019 \qquad \beta = 1\cdot693$$

The hypersthene and diopside were not analysed as they could not be separated from each other.

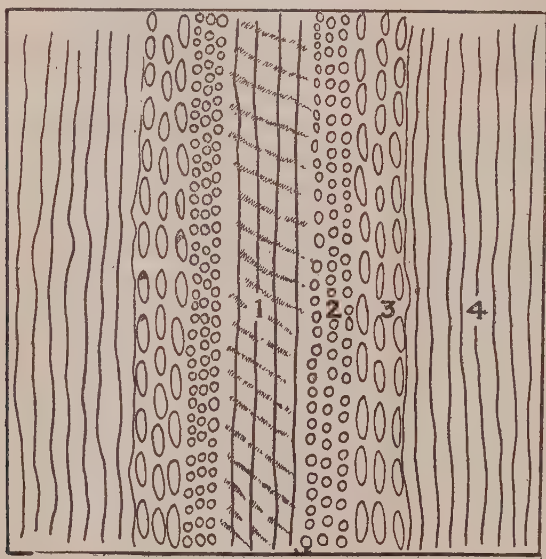
Both hypersthene and diopside are lamellar. The lamellae in diopside are clearer than in hypersthene. Following the continental setting, the lamellae in hypersthene are parallel to the optic axial plane (100) and in diopside, again parallel to (100), but perpendicular to the optic axial plane (010). These lamellae are, however, distinct from the broad lamellae seen in the orthopyroxenes of the pyroxenites occurring with the dunites in this area. These lamellae in the pyroxenes of the pyroxenites are parallel to (001) and the optic axial planes of the two individuals, make an angle of 7°—10° on the (100) faces. The lamellae in the hypersthene and diopside of charnockites are very narrow, often less than ·004 mm. thick, and their optics could not be determined. A detailed discussion of these lamellae has been given by Hess and Phillips (1938), Poldervaart (1947), Tilley (1936), Henry (1942) and Naidu (1955). Howie (1955) has analysed the hypersthene from Shervaroys. It contains only 0·90% of CaO and $Al_2O_3$ is more, while Hess and Phillips (1938) report about 2% of CaO uniformly from all hypersthene, accounting for the phenomenon of exsolution of CaO into about 10% of the diopside molecules.

Hornblende and some biotite are found secondary after the mafics and plagioclase. With well-developed crystals of these minerals as nuclei, the hornblende and biotite insinuate along the boundary of plagioclase and hypersthene and/or diopside, either corroding them or veining them. These veins often join up with larger ferromagnesian aggregates, and thus are found to link up groups of mafics. Similar phenomena of reactions have been

noted by Ghosh (1941) in the intermediate charnockites of Bastar. The optical characters of the hornblende are:

$$\begin{array}{lll} -2V = 84^\circ - 86^\circ & \gamma - \alpha = \cdot 022 \ \ \cdot 023 & \\ Z \wedge C = 20^\circ - 22^\circ & \gamma - \beta = \cdot 009 \ \ \cdot 010 & \beta = 1 \cdot 661. \end{array}$$

Progressive amphibolisation from mere patches to aggregates of amphiboles can be traced and with the increase of amphibole, the released iron-ore also increases. The accessories include iron-ore, apatite, pyrite end pyrrhotite. There are rims of biotite surrounding the iron-ore.




SKETCH 6

Rich Zone of garnet is developed near the Bahiaites in Shervaroys. This passes in to garnetiferous leptynite and then on to Intermediate charnockites.
1. Bahiaite; 2. Garnet-Zone;
3. Garnetiferous leptynite;
4. Intermediate charnockite.

Slides S. 52, R. 75, are free from amphibole and contain only plagioclase, antiperthite, quartz, hypersthene and diopside with a little iron-ore, biotite and apatite. But, the heterogeneity of texture is well-marked, the basic minerals always clustering into non-uniform lenticles and clots.

These pass on to types which are gneissose, wherein, the ferro-magnesians are crushed and are drawn out into stringers, parallel

with the elongation of quartz and felspar. Some crushed and elongated grains of ferromagnesians give rise to the gneissose banding. The foliation in the field is not continuous, but passes on gradually into the granulitic, unfoliated type.

Bahiaites in Shervaroys and xenoliths of bahiaites in Jarugamalai have a rich zone of garnet developed, which passes on to garnetiferous leptynite and then on to the intermediate charnockite. The succession is clearly seen particularly at the contact of the bahiaites with the intermediate charnockites in Shervaroys (sketch 6).

The garnetiferous leptynites at the contact contain plagioclase, quartz, garnet, a little hypersthene and diopside with iron-ore. The quartz grains are all clear, but the plagioclase has been completely sericitised. The garnets are mesh-structured and are traversed by veins of sericite. Except for the clear pools of quartz, the whole rock is altered. The garnets of the rich zone around, bahiaites are euhedral and have a sieve-structure with clear grains of quartz in the centre.

The specific gravity of this garnet is 4·11 and the refractive index is 1·790. This garnet was powdered to 120 mesh to remove the quartz grains occurring as inclusions, separated and analysed (Table XVII).

Neglecting the value of $Na_2O$, $K_2O$, $H_2O^+$, and $H_2O^-$ in the analysis, and recalculating to 100, the general formula of the mineral is,

$(Fe''', Fe'', Mg, Ca)_{3\cdot20}\ Al_{2\cdot00}\ (Si, Ti, Al)_{2\cdot94}O_{12}$, Ti being regarded as replacing Si. Recalculated in terms of standard mineral molecules, it has the composition,

| | |
|---|---|
| Almandite | .. 28·87% |
| Pyrope | .. 51·88% |
| Grossularite | .. 16·32% |
| Spessartite | .. 2·93% |

It is seen that, unlike the garnet from R. 43, the garnet-pyroxene rock, this garnet is predominantly rich in pyrope with subordinate amounts of almandite and grossularite. Heritsch (1927) has divided the pyrope into three groups, his third group containing over 50% pyrope, a fair amount of grossularite, over 10% of almandite, and no andradite. His garnet No. 24, which is from an eclogite from Kimberley, and is taken by him as the type of this group is given below for comparison.

## TABLE XVII

Chemical Analysis of Garnet from S. 42

| Oxides. | Wt %. | Recalculated to 100 Wt %. | Mol. No. | Metal atoms. | (O, OH, F). | Basis 12 (O, OH, F). | | | Valency check. | |
|---|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 36·34 | 37·10 | 618 | 618 | 1236 | 2·75 | | 2·94 | $Si^{++++}$ | 11·00 |
| $TiO_2$ | 0·15 | 0·15 | 3 | 3 | 6 | 0·01 | | | $Ti^{++++}$ | 0·04 |
| $Al_2O_3$ | 24·52 | 25·03 | 245 | 490 | 735 | 2·18 | 0·18<br>2·00 | 2·00 | $Al^{+++}$ | 6·54 |
| $Fe_2O_3$ | 0·11 | 0·11 | 1 | 2 | 3 | 0·01 | | | $Fe^{+++}$ | 0·03 |
| FeO | 14·51 | 14·81 | 206 | 206 | 206 | 0·92 | | | $Fe^{++}$ | 1·84 |
| MnO | 1·35 | 1·38 | 20 | 20 | 20 | 0·09 | | 3·20 | $Mn^{++}$ | 0·18 |
| MgO | 14·61 | 14·91 | 373 | 373 | 373 | 1·66 | | | $Mg^{++}$ | 3·32 |
| CaO | 6·35 | 6·51 | 116 | 116 | 116 | 0·52 | | | $Ca^{++}$ | 1·04 |
| $Na_2O$ | 0·26 | | | | | | | | | |
| $K_2O$ | 8·81 | 100·00 | | | 2695 | | | | | 23·99 |
| $H_2O^+$ | 0·32 | | | | | | | | | |
| $H_2O^-$ | 0·26 | | | | | | | | | 24·00 |
| | 99·59 | | | | | | | | | |
| Sp. Gr. | 4·11 | | | | | | | | | |

Formula: $(Fe''', Fe'', Mn, Mg, Ca)_{3\cdot20}\ Al_{2\cdot00}\ (Si, Ti, Al)_{2\cdot94}\ O_{12}$

Analyst, S. Ramanathan.

| | | I | II |
|---|---|---|---|
| Almandite | .. | 28·77 | 12·6 |
| Pyrope | .. | 51·88 | 50·9 |
| Grossularite | .. | 16·32 | 36·0 |
| Spessartite | .. | 2·93 | 0·5 |

1. Garnet, S. 42, from Shervaroys, Salem.
2. Garnet, from Eclogite, Blauer Grund, Kimberley, Doelter (Ref. Heritsch, 1927).

This analysed garnet occupies a place between Kimberlite-peridotite and various basic rocks in the table prepared by wright (1938) (Refer Table VI).

G. 52, intermediate charnockite, from the top of Shervaroys and R. 75, from the foot of Shervaroys, were chemically analysed and the analysis are given in Table XVIII. The modal composition of the two rocks are given below:

Table XVIII

| Oxides. | | I | II | III | IV | V |
|---|---|---|---|---|---|---|
| $SiO_2$ | .. | 61·56 | 57·31 | 59·77 | 63·85 | 63·77 |
| $TiO_2$ | .. | 0·53 | 0·33 | 0·96 | 0·83 | n.d. |
| $Al_2O_3$ | .. | 15·74 | 18·31 | 14·83 | 14·87 | 16·30 |
| $Fe_2O_3$ | .. | 2·89 | 2·29 | 2·20 | 2·32 | 7·49 |
| FeO | .. | 3·16 | 4·70 | 7·01 | 5·07 | n.d. |
| MnO | .. | Tr | 0·08 | 0·13 | 0·05 | n.d. |
| MgO | .. | 3·47 | 4·41 | 4·31 | 3·29 | 2·49 |
| CaO | .. | 5·73 | 6·26 | 4·24 | 4·48 | 6·33 |
| $Na_2O$ | .. | 5·41 | 4·41 | 3·88 | 3·72 | 3·68 |
| $K_2O$ | .. | 1·40 | 1·69 | 1·39 | 1·09 | 1·21 |
| $P_2O_5$ | .. | 0·04 | 0·02 | 0·23 | 0·08 | n.d. |
| $H_2O^+$ | .. | 0·44 | 0·38 | 0·09 | 0·11 | |
| $H_2O^-$ | .. | 0·03 | 0·11 | 0·24 | 0·19 | |
| Total | .. | 100·40 | 100·30 | 99·82 | 99·95 | 101·27 |
| Sp. Gr. | .. | 2·75 | 2·73 | 2·84 | 2·97 | 2·77 |

I. G. 52., Intermediate charnockite, Top of Shervaroys Salem. Analyst, S. Ramanathan.
II. R. 75. Intermediate charnockite, Foot of Shervaroys, Salem. Analyst, S. Ramanathan.
III. 4641. B. Shervaroy Hills, Madras, Analyst, J. H. Scoon. (Howie 1955).
IV. Intermediate rock, Yercaud, Shervaroy Hills, Madras H. S. Washington.
V. Same locality, Analyst, T. L. Walker. (Holland, 1900).

G. 52: quartz 10·0%, plagioclase 33·5%, antiperthite 36·0%, hornblende 2·8%, hypersthene 4·5%, diopside 9·5% and ores 3·7%.

R. 75: quartz 8·3%, plagioclase + antiperthite 70·4%, hypersthene 12·2%, diopside 4·0% and ores 5·1%.

The C.I.P.W. Norm, Niggli values, Niggli Basis, and Katamolecular norm of the analysed rocks were calculated (Table XIX).

Table XIX

G. 52

| C.I.P.W. Norm. | | Niggli values. | | Niggli basis. | | Katanorm. | |
|---|---|---|---|---|---|---|---|
| Q | 10·38 | al | 29·33 | cp | — | Q | 7·38 |
| Or | 8·34 | fm | 31·81 | Kp | 4·96 | Or | 8·26 |
| Ab | 45·59 | c | 19·43 | Ne | 28·79 | Ab | 47·99 |
| An | 14·46 | alk | 19·43 | Cal | 8·60 | An | 14·34 |
| Di | 11·09 | Si | 195·4 | Cs | 4·14 | Wo | 6·21 |
| Hy | 6·05 | ti | 1·14 | Fs | 2·98 | En | 9·64 |
| Mt | 4·18 | k | 0·147 | Fo | 7·23 | Hy | 2·87 |
| Il | 0·91 | mg | 0·521 | Fa | 3·64 | Mt | 2·98 |
| | | | | Ru | 0·33 | Ru | 0·33 |
| | | | | Q | 39·33 | | |

R. 75

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Q | 3·66 | al | 30·60 | Kp | 5·96 | Q | 3·04 |
| Or | 10·01 | fm | 34·86 | Ne | 23·51 | Or | 9·94 |
| Ab | 37·20 | C | 19·32 | Cal | 14·90 | Ab | 39·19 |
| An | 25·02 | alk | 15·22 | Cs | 1·93 | An | 24·84 |
| Di | 5·19 | Si | 163·2 | Fs | 2·32 | Wo | 2·57 |
| Hy | 14·68 | ti | 0·68 | Fo | 9·11 | En | 12·15 |
| Mt | 3·25 | k | 0·202 | Fa | 5·46 | Hy | 5·73 |
| Il | 0·93 | Mg | 0·539 | Ru | 0·22 | Mt | 2·32 |
| | | | | Q | 36·59 | Ru | 0·22 |

It is seen that the analysis No. 1 resembles No. 4, of Washington (1916) closely, while No. 2 resembles No. 3 (Howie, 1955) closely. As between Nos. 1 and 2, it is seen that the intermediate charnockite from the top of Shervaroys is richer in silica, than the one from the foot of Shervaroys. It is also seen from the modal composition, C.I.P.W. Norm and Katanorm that the percentage of mafics in both the specimens analysed, is almost the same.

The formula of the rocks after Barth (1951) would be:

(1) G. 52: $K_{1\cdot62}$ $Na_{9\cdot39}$ $Ca_{5\cdot51}$ $Mg_{4\cdot75}$ $Fe_{4\cdot58}$ $Al_{16\cdot63}$ $Si_{55\cdot38}$ $Ti_{0\cdot32}$ $[O_{154\cdot6}\,(OH)_{5\cdot4}]160$.

(2) R. 75. $K_{1\cdot9}$ $Na_{7\cdot8}$ $Ca_{6\cdot2}$ $Mg_{6\cdot0}$ $Fe_{6\cdot1}$ $Al_{19\cdot5}$ $Si_{52\cdot3}$ $Ti_{0\cdot2}$ $[O_{157\cdot6}\,(OH)_{2\cdot4}]160$.

The transfer of the cations for the conversion of one rock to the other can be worked out as in the case of the garnet-pyroxene rocks.

*Group 2:* This group of intermediate charnockites is characterized by the clouding of the felspars while quartz grains occur in clear pools. The minerals are crushed but not to the extent seen in the Shervaroys type, and occur as irregular bands and lenticles lower down.

These may be subdivided again, as in the case of group 1, into hornblende-hypersthene, diopside bearing, hornblende-free and gneissose types.

The plagioclase has occasionally well developed cleavages. The anorthite content of the plagioclase of the three types is given below:

(1) Hornblende-free types, granulitic, R. 158 — $An_{30}$ to $An_{40}$.

(2) Hornblende-hypersthene-diopside — bearing, granulitic, R. 46, — $An_{25}$ to $An_{30}$.

(3) Gneissose types, R. 60 — $An_{25}$ to $An_{35}$.

There is a little potash felspar present in R. 46, R. 158 and some other sections with $-2V = 76° - 79°$.

The hypersthene and diopside are again lamellar and occur either as big plates or crushed and drawn out into stringers. Still one portion of the rock may be purely leptytic, while the other portion may resemble a typical basic granulite. Wisps of biotite are found to develop as rims around ore and hypersthene grains in all the rocks and they grow into full—sized brown flakes in R. 60. Hornblende is green in colour and clearly secondary developing around grains of diopside and hypersthene and insinuate along the borders of plagioclase.

The optical characters of the different minerals are given below:

*R.* 158:

Hypersthene:

$-2V = 54° - 57°$ $(\gamma - \alpha) = {\cdot}016$ $\gamma - \beta = {\cdot}004$ $\beta = 1{\cdot}706$

Diopside:

$+2V = 55° - 56°$ $(\gamma - \alpha) = {\cdot}023$
$Z \wedge C = 39°$ $(\gamma - \beta) = {\cdot}018$ $\beta = 1{\cdot}696$

*R.* 46:

Hypersthene:

$-2V = 55° - 60°$ $(\gamma - \alpha) = {\cdot}015$ $\gamma - \beta = {\cdot}004$

Diopside:

$+2V = 55° - 57°$ $(\gamma - \alpha) = {\cdot}024$
$Z \wedge C = 38° - 39°$ $(\gamma - \beta) = {\cdot}018$

Hornblende:

$-2V = 86°$ $(\gamma - \alpha) = {\cdot}018 - {\cdot}020$
$Z \wedge C = 22°$ $(\gamma - \beta) = {\cdot}007$

*R.* 60:

$-2V = 64° - 66°$ $(\gamma - \alpha) = {\cdot}015$
$(\gamma - \beta) = {\cdot}004$ $\beta = 1{\cdot}688.$

Quartz is present in all the slides. Apatite, iron-ore and biotite form the chief accessories.

R. 158 and R. 60 have been chemically analysed (Table XX).

Table XX

| Oxides | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| $SiO_2$ .. | 61·44 | 58·43 | 59·17 | 59·50 | 64·82 | 59·29 |
| $TiO_2$ .. | 0·90 | 0·22 | 0·99 | 1·68 | 0·24 | 0·62 |
| $Al_2O_3$ .. | 18·36 | 18·13 | 15·53 | 18·71 | 14·74 | 14·22 |
| $Fe_2O_3$ .. | 0·61 | 2·17 | 2·03 | 2·32 | 1·96 | 1·21 |
| FeO .. | 3·58 | 3·00 | 5·40 | 3·96 | 5·41 | 5·18 |
| MnO .. | Tr | 0·20 | 0·06 | — | 0·14 | 0·92 |
| MgO .. | 4·44 | 4·15 | 2·94 | 3·49 | 3·44 | 1·88 |
| CaO .. | 4·93 | 6·41 | 5·68 | 5·10 | 4·98 | 2·75 |
| $Na_2O$ .. | 4·93 | 5·24 | 4·22 | 3·82 | 3·98 | 4·01 |
| $K_2O$ .. | 0·97 | 1·02 | 3·19 | 1·18 | 0·83 | 0·98 |
| $P_2O_5$ | — | — | 0·47 | 0·07 | 0·10 | 0·40 |
| $H_2O+$ | 0·56 | 0·60 | 0·11 | 0·60 | 0·12 | 0·05 |
| $H_2O-$ | 0·13 | 0·10 | 0·14 | | | |
| Total | 100·85 | 99·67 | 99·93 | | 100·76 | 100·51 |
| Sp. Gr | 3·00 | 2·67 | 2·80 | | | |

I. Intermediate charnockite, gneissic type, R. 60. Salem. Analyst, S. Ramanathan.
II. Intermediate charnockite, Hornblende free, R. 158, Salem. Analyst, S. Ramanathan.
III. 122, Intermediate rock, Velegan Pothai, Nr. Tenkar, Tinnevelley District, Analyst, R.A. Howie.
IV. Hypersthene-granite. Mt. San. Ivory coast. Analyst, Pisani (Groves 1935).
V. Intermediate charnockite, Pachaimalai, Analyst, N. Leelananda Rao.
VI. Intermediate charnockite from the main rage of hills in Kondapalle, west of △ 245, Analyst, Sri Rama Rao.

The modes of the analysed rocks are given below:

| | Plagioclase. | Anteperthite. | Quartz. | Hyp. | Diop. | Biotite. | Ores. |
|---|---|---|---|---|---|---|---|
| R. 60 | 40·7 | 29·9 | 8·4 | 12·1 | — | 5·4 | 3·5 |
| R. 158 | 40·3 | 37·0 | 5·0 | 10·0 | 5·7 | — | 2·0 |

The C.I.P.W. Norm, Niggli values, Niggli Basis and Katamolecular norm of the analysed rocks are given in Table XXI.

Table XXI

R. 60

| C.I.P.W. Norm. | | Niggli values. | | Niggli basis. | | Katanorm. | |
|---|---|---|---|---|---|---|---|
| Q | 9·72 | al | 34·35 | Kp | 3·61 | Q | 8·27 |
| Or | 6·12 | fm | 31·67 | Ne | 25·92 | Or | 6·01 |
| Ab | 41·39 | c | 16·80 | Cal | 14·42 | Ab | 43·20 |
| An | 24·46 | alk | 17·18 | Fs | 0·66 | An | 24·04 |
| C | 0·20 | si | 195·4 | Fo | 8·91 | Cord | 0·61 |
| Hy | 15·72 | ti | 0·21 | Fa | 3·88 | En | 11·88 |
| Mt | 0·93 | k | 0·122 | Ru | 0·60 | Hy | 4·73 |
| Il | 1·67 | mg | 0·688 | Q | 41·67 | Mt | 0·66 |
| | | | | Sp | 0·33 | Ru | 0·60 |

R. 158

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Q | 4·56 | al | 31·44 | Kp | 3·64 | Q | 4·02 |
| Or | 6·12 | fm | 31·44 | Ne | 27·81 | Or | 6·06 |
| Ab | 44·01 | C | 20·24 | Cal | 13·57 | Ab | 46·35 |
| An | 22·80 | alk | 16·88 | Cs | 2·65 | An | 22·62 |
| Di | 7·10 | si | 173·0 | Fs | 2·32 | Wo | 3·53 |
| Hy | 10·70 | ti | 0·532 | Fo | 8·61 | En | 11·48 |
| Mt | 3·25 | k | 0·116 | Fa | 3·75 | Hy | 3·45 |
| Il | 0·46 | mg | 0·688 | Ru | 0·17 | Mt | 2·32 |
| | | | | Q | 37·48 | Ru | 0·17 |

It is evident from the tables that these intermediate charnockites are not chemically very much different from the Shervaroys type. It is again seen that the proportion of the mafic minerals is practically the same as in the other two reported earlier. The analyses are similar to those of intermediate charnockites, reported from elsewhere.

The formula of the rocks would be (Barth, 1951):

1. *R.* 158:

$$K_{1\cdot20}\ Na9._{12}\ Ca_{6\cdot20}\ Mg_{5\cdot66}\ Fe_{4\cdot05}\ Al_{19:26}\ Si_{52\cdot99}\ TiO._{16}\ [O_{152\cdot8}\ (OH)_{7\cdot2}]\ 160.$$

2. *R.* 60:

$$K_{1\cdot17}\ Na_{8\cdot38}\ Ca_{4\cdot67}\ Mg_{5\cdot89}\ Fe_{3\cdot36}\ Al_{19\cdot10}\ Si_{54\cdot33}\ Ti_{0\cdot58}\ [O_{153}\ (OH)_{7}]\ 160.$$

The variegated gneisses and the intermediate charnockites at their contacts pass one into the other. Marginally, the intermediate charnockites are very much crushed and the crushed portions have been melted into an opaque amorphous substance. These pseudo-tachylites have been mentioned by Holland (1900) in his memoir on the charnockites as "Trap-shotten" gneisses. Similar trap-shotten phenomena have been noted from the type area, and by Rama Rao (1945) in Mysore.

The pseudotachylite has been studied microscopically. At the contact of the amorphous mass with the intermediate charnockite the felspars and hypersthene grains are crushed and drawn out into fine veins and stringers. The plagioclase grains in the intermediate charnockite portion is undulose and the An. content is about 28-30%. The hypersthene is lamellar with $-2V = 55° - 57°$. Inside the amorphous portion, there are mosaic grains of rounded quartz and a few grains of plagioclase of composition $Ab_{70}$ $An_{30}$. There are a few occasional grains of hypersthene with $-2V=55°$. The hypersthene grains are crushed and traversed by veins. The amorphous portion is dark and opaque. Its specific gravity varies from 2·71 to 2·76 and R.I. $= 1{\cdot}566 - 1{\cdot}572$.

The pseudo-tachylitic portion was analysed and the analysis is given in Table XXII.

TABLE XXII

| Oxides | | I | II | III |
|---|---|---|---|---|
| $SiO_2$ | .. | 62·65 | 68·90 | 60·88 |
| $TiO_2$ | .. | 0·48 | 0·68 | 0·63 |
| $Al_2O_3$ | .. | 18·09 | 10·09 | 16·65 |
| $Fe_2O_3$ | .. | 0·90 | 1·58 | 2·85 |
| FeO | .. | 3·07 | 6·59 | 4·42 |
| MnO | .. | 0·02 | 0·26 | 0·08 |
| MgO | .. | 3·13 | 4·11 | 3·79 |
| CaO | .. | 4·92 | 2·32 | 5·48 |
| $Na_2O$ | .. | 3·77 | 3·17 | 4·47 |
| $K_2O$ | .. | 1·92 | 1·85 | 1·25 |
| $H_2O^+$ | .. | 0·71 | 0·92 | 0·37 |
| $H_2O^-$ | .. | 0·13 | 0·07 | 0·12 |
| Total | .. | 99·79 | 100·54 | 100·99 |
| Sp. Gr. | .. | 2·71-2·76 | — | 2·79 |

I. Pseudotachylite, Salem, Analyst, S. Ramanathan.
II. M2/2. From the dark grey Trapshotten band, West of Sivasamudram, Analyst, B. S. Raju. (Rama Rao, 1945).
III. Average of seven analysis of intermediate charnockites from Salem. (Four by S. Ramanathan and one each by J. H. Scoon, H. S. Washington and T. L. Walker).

It is seen from the table that the analysed pseudotachylite resembles very closely the average intermediate charnockite from the area. The specific gravity also is the same. Also, the hypersthenes and plagioclases occurring as inclusions in the pseudo-tachlytic portion, and those occurring in the adjacent intermediate charnockites have the same optical characters. On these optical and chemical evidences, it is concluded that the pseudotachylites are the result of brecciation of the intermediate charnockites. This zone of brecciation is found at the foot of Sherveroys and at the foot of Jarugamalai.

*Petrogenesis*

Holland (1900) regarded the charnockite series as igneous rocks differentiated. Since then, opinion has swung towards assigning a metamorphic origin to these rocks. Eskola (1952) summarises this position by saying that many more regard them as "metamorphic rocks derived from various primary materials". Groves (1935) and Howie (1955) regard them as igneous rocks metamorphosed.

A colour index diagram (Fig. 2) representing the modal composition of the analysed hypersthene bearing rocks has been prepared.

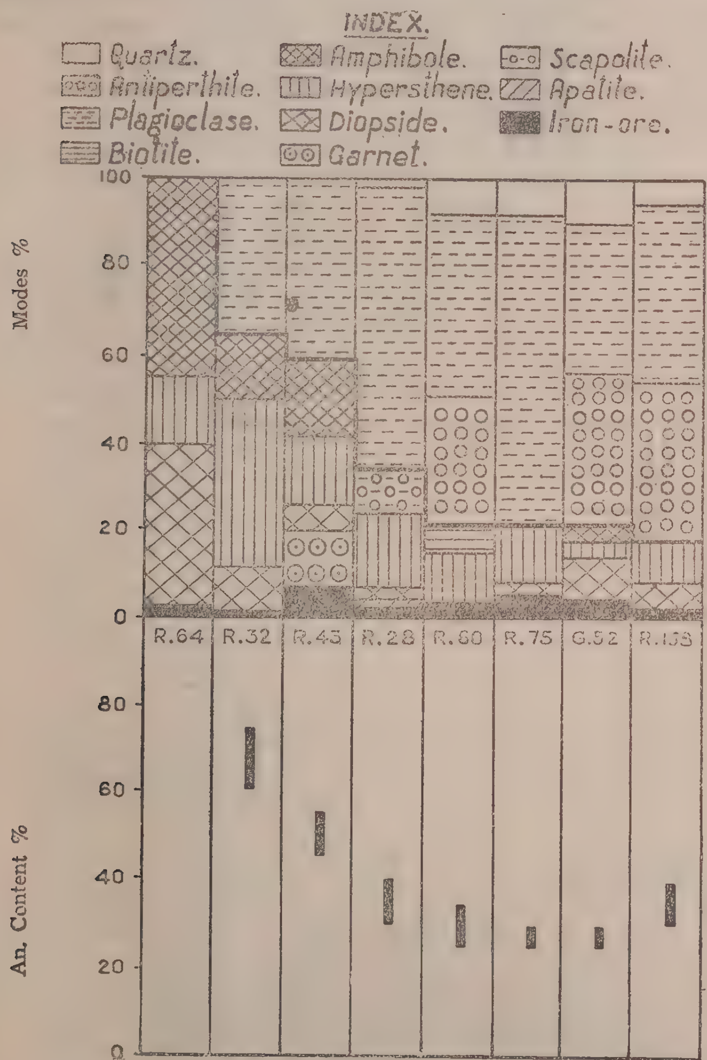



FIG. 2
Colour index diagram illustrating the relationship of the An. content of plagioclase felspar and mode of parent rocks.

This is compared with the diagram representing anorthite content of the plagioclases in the respective rocks. It is found

that there is a general parallel relation between the anorthite content and the colour index. The anorthite content of the plagioclase is higher in rocks that contain greater amount of the mafics. The plagioclase of these rocks have an anorthite content ranging from acid bytownite to calcic oligoclase. In this respect, the colour index diagram of this area corresponds to the one prepared by Naidu (1955) for the Vellore area. He, however, refers to a stepwise relation and not a parallel increase of modal colour index and anorthite content, for the Salem rocks. His diagram was, however, based on specimens collected from Shervaroys and Kasumalai alone, while the present diagram deals with the intermediate charnockites and also the garnet pyroxene rocks. It is seen that there is no plagioclase at all in the rock R. 64 containing the maximum amount of amphibole, and the anorthite content is higher when the amount of amphibole is higher. This diagram leads one to believe that there is a genetic relationship between the garnet pyroxene rocks and the intermediate charnockites.

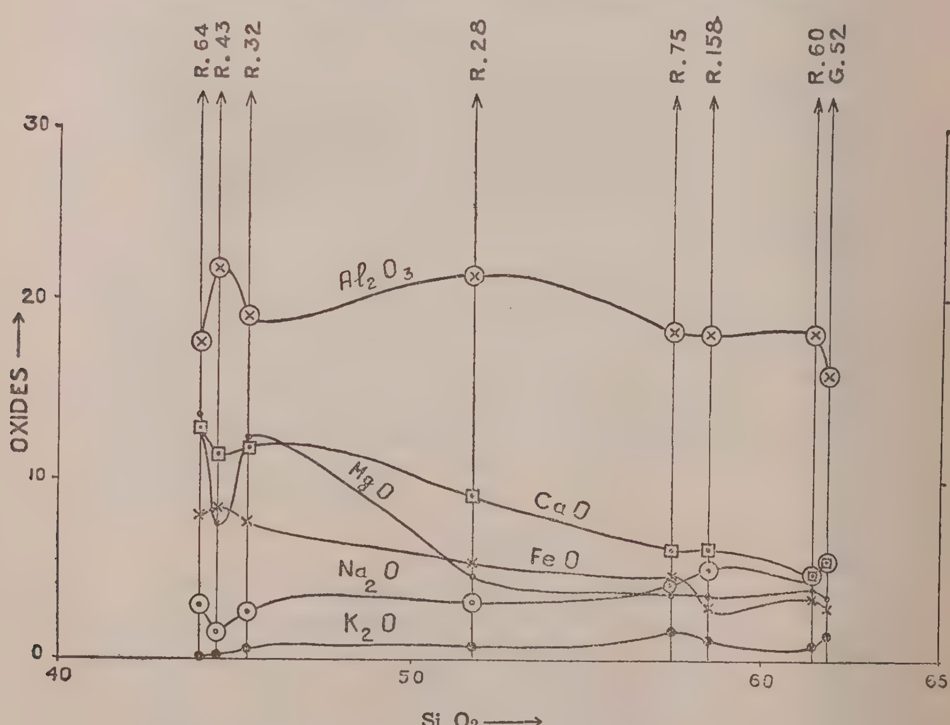



FIG. 3
Variation diagram after Harker.

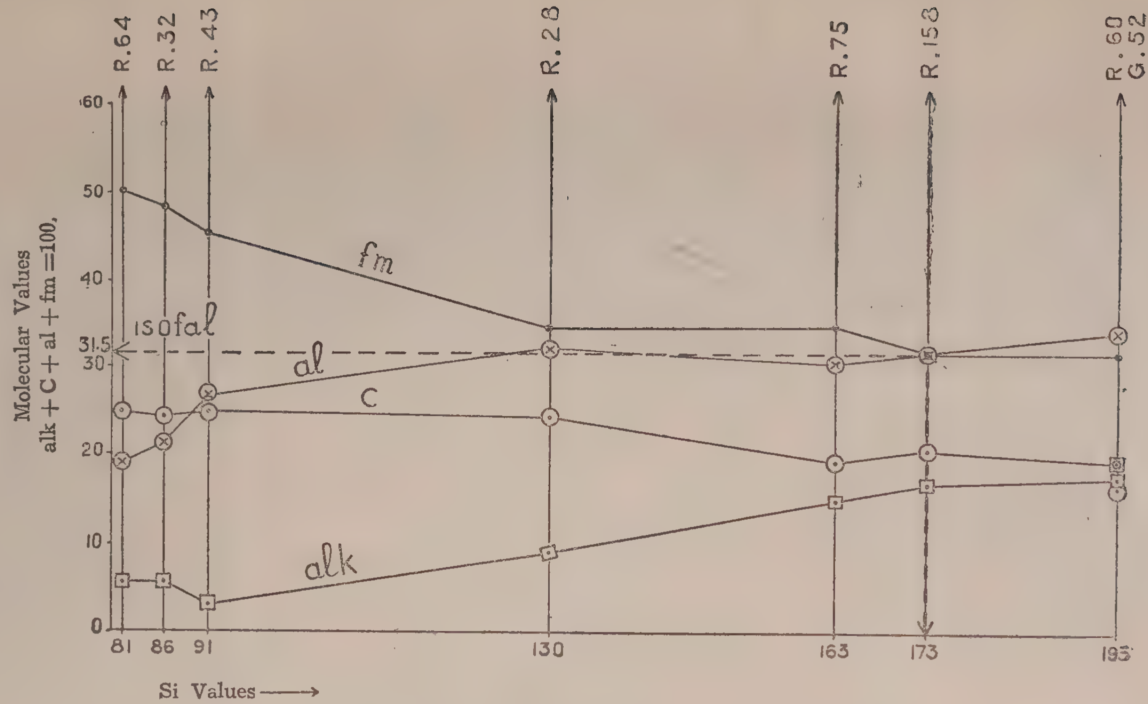



FIG. 4

Variation diagram after Niggli. The isofal is at si = 173 and al = fm = 31·5.

To verify this relationship, a variation diagram after Harker was drawn (Fig. 3).

The curves are not smooth, especially towards the garnet-pyroxene end. This does not confirm the genetic relationship.

A variation diagram after Niggli (1945) was also prepared (fig. 4).

The isofalic point is at the si value 173 and the value of fm = al = 31·5. This corresponds very well to the pacific suite for which the corresponding values are si = 176 and al = fm = 32. This variation diagram confirms the conclusions reached by the colour-index diagram (fig. 2).

Also a variation diagram after the method of Larsen (1938), modified by Nockolds (1953) has been drawn in Fig. 5.

The weight percentages of the elements are plotted in this against (1/3 si + K) — (Ca + Mg), Fe being "omitted from this base in order that any iron-enrichment may be apparent". It is evident that there is a fairly regular variation from + 5 to — 5, but beyond — 5, (the garnet pyroxene rocks), the variation is not uniform. Above — 5, all the elements have got an uniform smooth variation. Potassium and sodium seem to increase more sharply towards the end (near + 5), while Ca, Fe, Mg and Al curves show a gradual decline. The garnet pyroxene rocks reach a value of — 5 to — 10, and in this portion of the curve only, the variation does not keep up to the uniform smoothness of the intermediate charnockites suggesting that the garnet-pyroxene rocks may not belong to, or represent the ultrabasic members of the charnockite series, of which the intermediate charnockites are members.

A Q L M diagram (Fig. 6) was drawn of all the rocks and minerals analysed from Salem, with only a bahiaite from Pallavaram. It is seen that the analyses of Howie (1955) and Washington (1916) resemble the trend of differentiation of the igneous series of the Pacific suite of Burrie and Niggli (1945), as suggested by Naidu (1955) by plotting Washington's analyses for the charnockite series. These analyses of Howie and Washington are of rocks from Madras and Salem, 200 miles apart. A similar curve, when drawn, using the Q L M values of the rocks from Salem alone, analysed by the author, passes through points of all the three suites, Pacific, Atlantic and Mediterranean. None of the minerals, analysed either by Howie (1955), or by the author, have a

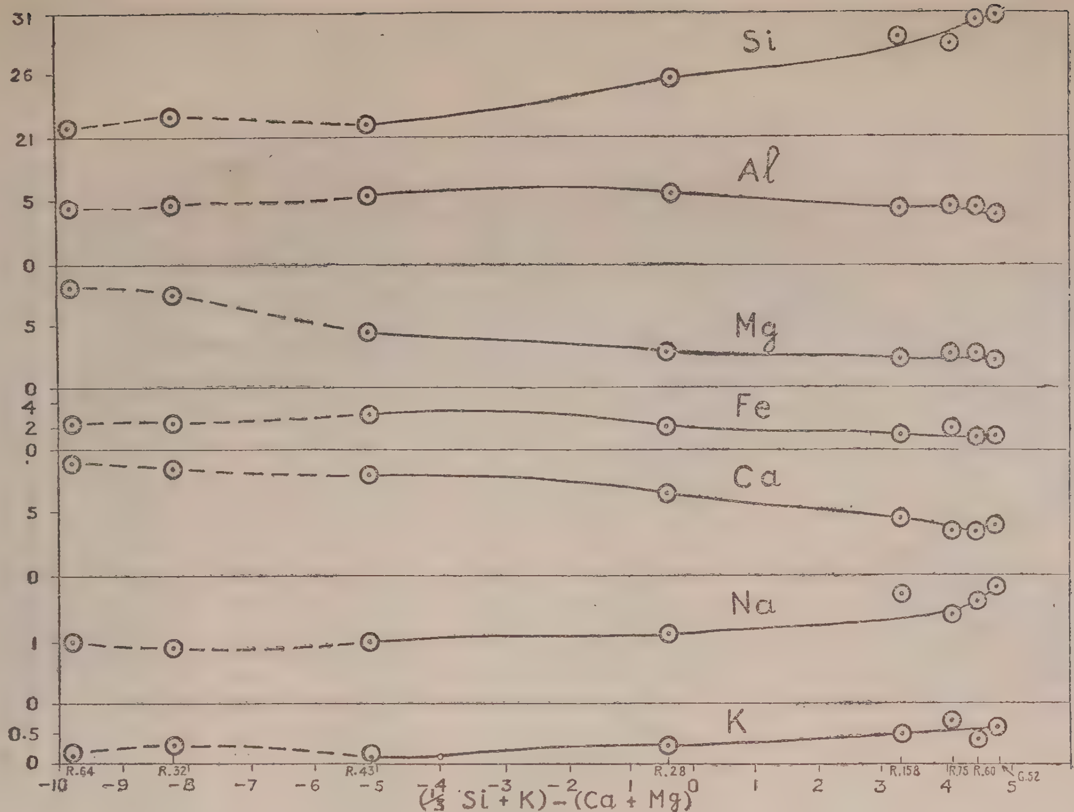



Fig. 5

Variation diagram after Larsen and Nockolds. The weight percentages of the elements are plotted against (1/3 si + K) − (Ca + Mg).

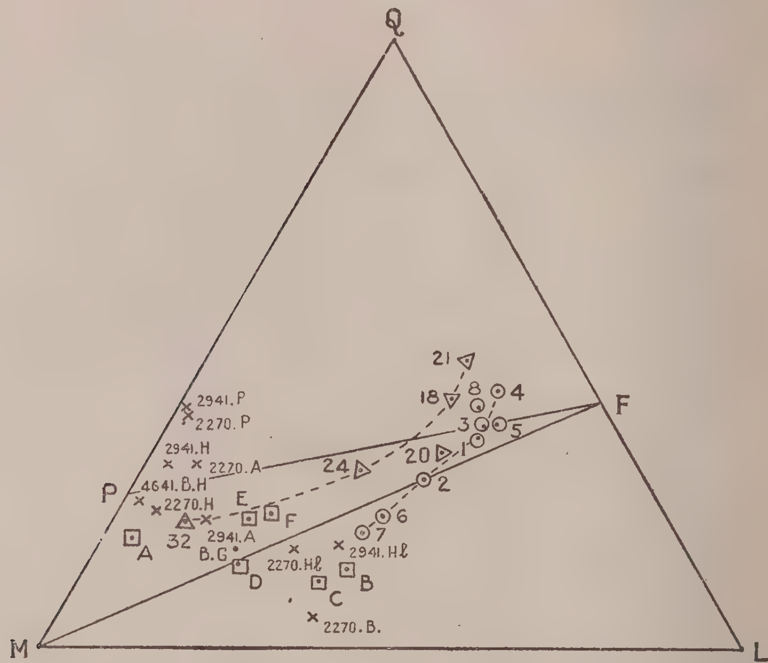



Fig. 6

Q L M diagram of rocks and minerals of the charnockite series of Salem. The circles with point at the centre are the rocks analysed by the author, while the squares with point at the centre are the minerals analysed by the author. The triangles with point at the centre are the rocks analysed by others and the multiplication symbol (X) represents the minerals analysed by Howie.

1. R. 28; 2. R. 43; 3. R. 75. 4. R. 60. 5. R. 158. 6. R. 32; 7. R. 64; 8. G. 52.

A — Clinopyroxene from garnet-pyroxene rock. B — Brown Aphibole from garnet-pyroxene rock. C — Greenish brown amphibole from Bahiaite, Shervaroys. D — Green amphibole from Bahiaite, Namam Hill. E — Garnet from Shervaroys. F — Garnet from garnet-pyroxene rock.

18. 4641.B. Shervaroy Hills, Howie; 20. 2270. Intermediate rock, Salem Howie; 21. G.S.I. 11·915. Shervaroys, Washington. 24. 2941. Norite, Salem Howie; 32. G.S.I. 9·672. Bahiaite, Pammal Hill, Madras, Washington.

| | | | |
|---|---|---|---|
| 2941. P. Plagioclase | 2270. B.H. | Hypersthene |
| 2270. P. Potash-felspar | 4641. B.H. | Hypersthene |
| 2270. B. Biotite | 2941. H. | Hypersthene |
| 2270. Hb. Hornblende | 2270 A. | Augite |
| 2941. Hb. Hornblende | 2941 A. | Augite |

subtraction relation to the suite of rocks (Naidu, 1955). Hornblende alone has this relation. But this is not a primary mineral. The evidence is rather that a widespread amphibolisation of all the rocks in this area points to a metamorphism contemporaneous in space and time.

Looking at the conflicting evidences of each of these diagrams, the author is not justified in drawing any definite conclusions of origin from these curves. However, these diagrams and the chemical, textural, mineralogical and field evidences, seem to suggest that the garnet-pyroxene rocks are not the ultrabasic members of the charnockite series of which the intermediate charnokite is a member.

The garnet-pyroxene rocks (with eclogitic elements) are then taken to be the earliest igneous intrusives into this areas, and they are surrounded by a narrow zone of metamorphic rocks of andalusite-actinolite schists and actinolite-talc schists. The felspars in these rocks are due to a later infusion on evidences suggested earlier. The amphiboles are also secondary, as products of reaction between the felspathic infusion and the mafics of the originally eclogitic rocks. The other alternative is to regard them as sediments metamorphosed, since they are interbedded with iron ores. But evidence in this direction is lacking.

The basic granulites near Omalur and the bahiaites are taken as derivatives from the garnet-pyroxene rocks on account of similar textures seen in them. This conclusion is further strengthened by the brown hornblende which occur in both the rocks. These are considered as older than the variegated gneisses, since they do not have intrusive contacts with them, but occur in them as lenticles.

The intermediate charnockites are regarded as migmatite products derived from the injection of a leptite magma into the older basic granulites, again on evidences suggested earlier. It is interesting to note that the leptitic portion of the slides of the Shervaroys charnockites resembles exactly the leptites associated with the magnetite-quartz rocks. Both the leptite portions are rich in iron ore. This statement involves the assumption that the magnetite quartz rocks of Kanjamalai are leptites and igneous in origin. This matter will be dealt with in a separate paper.

The dunites, potassic rocks and dolerites form the later intrusives. The petrography of the last two have been published

earlier (Ramanathan 1954, 1955). The petrography of the dunites is under preparation.

The analyses were plotted in an ACF diagram of Eskola (1939) appropriate to the granulite facies. (Fig. 7). It is seen that all the rocks analysed conform closely to the ideal assemblage of this facies, falling inside the triangle diopside-anorthite-hypersthene.

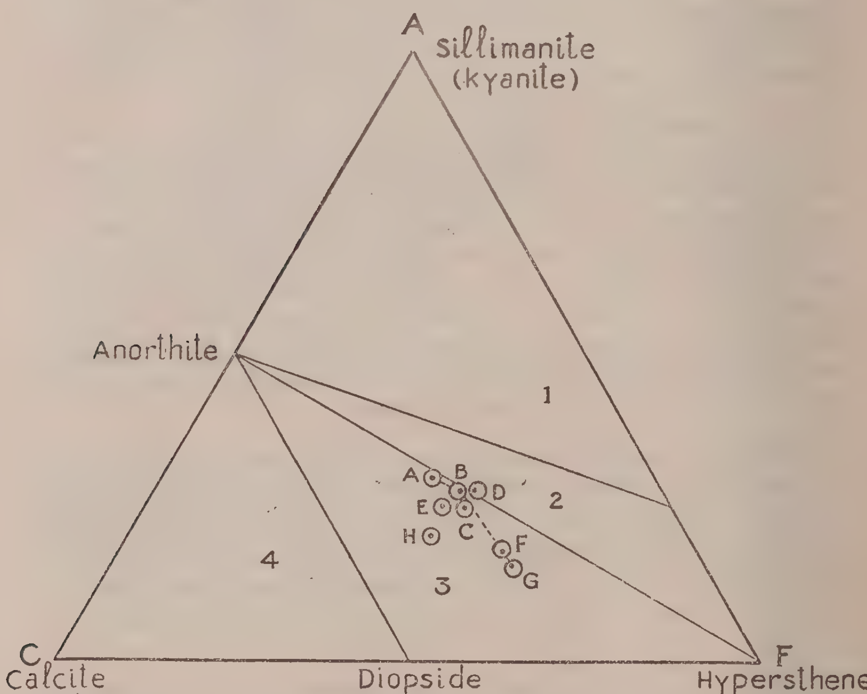



FIG. 7

A C F diagram for the granulite facies.
A — R.28; B — R.43; C — R.75; D — R.60; E — R.158; F — R.32; G — R.64; H — G.52.
All the points fall inside the diopside-hypersthene-anorthite field.

It is hereby inferred that the hypersthene bearing rocks of Salem are metamorphic rocks crystallised under the conditions of the "granulite facies."

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# Studies in the Acanthaceae. Microsporogenesis in Justica betonica, Barleria prionotis and Ruellia tuberosa

BY

C. R. NARAYANAN,
*American College, Madurai*

## *Introduction*

Although embryological work pertaining to some species of this large family has been published (Mauritzon 1934), meiotic studies in the anther have not received much attention. Some cytological work has been done recently (Narayanan, 1952), in some species. The present study of microsporogenesis in *Justicia betonica, Barleria prionotis* and *Ruellia tuberosa* is in continuation of the previous work of the author in the family. All the three species occur wild in nature. *Barleria prionotis* is a species which finds a place in gardens because of its golden yellow flowers. Its flowering period unlike the other two is limited from December to February of the year. The species also appears considerably sterile, judging from the failure in germination of numerous seeds which were grown in the laboratory. *J. betonica* appears fertile judging from the occurrence of seedlings around standing older plants. For the study of the somatic chromosomes of both the species (Narayanan, 1952) roots were raised from cuttings. Almost all the stages of microsporogenesis were got in both the species. In *R. tuberosa,* some of the meiotic stages recorded here occurred mixed in sections of the same flower buds.

## *Materials and Methods*

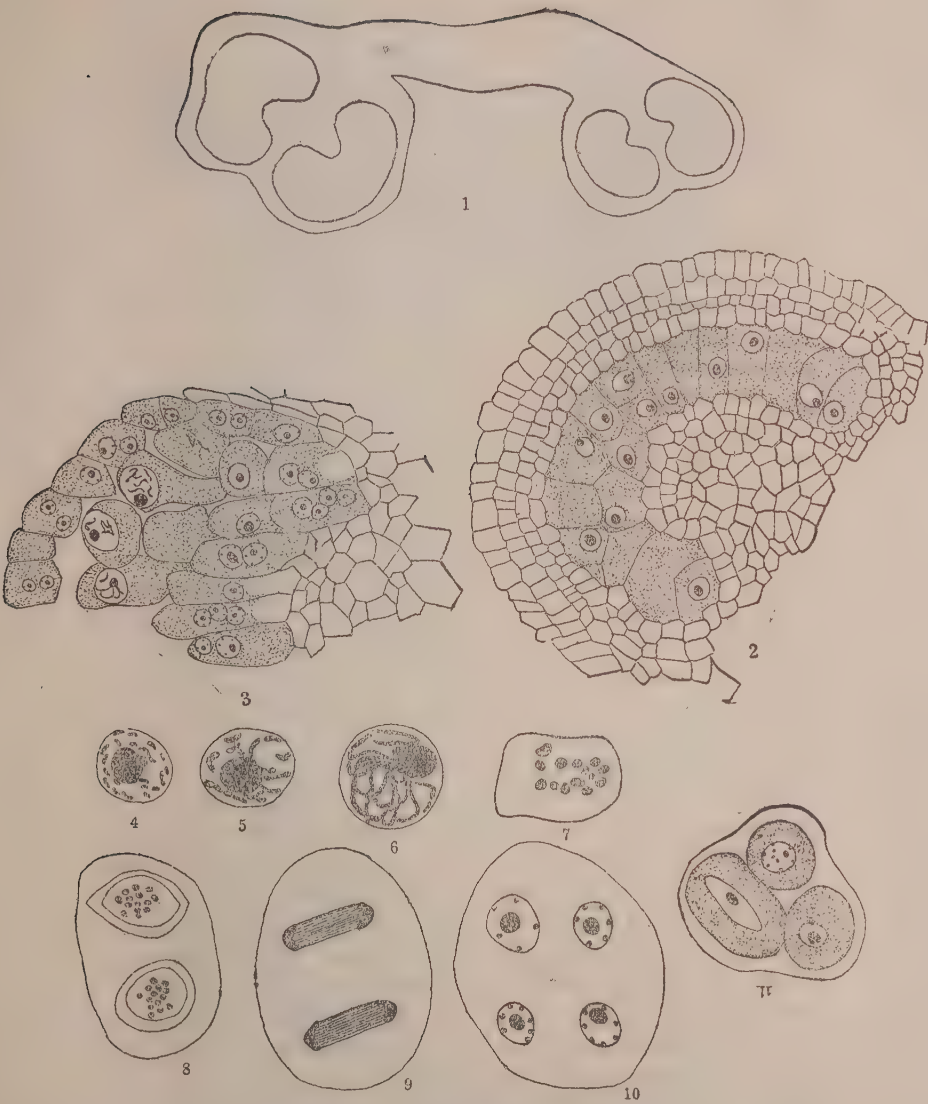
The paraffin method was adopted. Flower buds, after the removal of the sepals were fixed in Navashin's fluid for 24 hours, after prefixation in Carnoy's fluid (6 alcohol, 3 chloroform 1 g. acetic acid) for 45 seconds, and also in Sass's modified Bouin's fluid (Johansen, 1940). Material fixed in Bouin's fluid was washed in 25% alcohol and that in Navashin's in lukewarm distilled water. Dehydration and clearing was done in the usual way. Chloroform was employed as the solvent for paraffin. Sections

from 10 to 18 microns were cut. Material fixed in Bouin's fluid was stained in Haidenhain's iron alum haematoxylin and that in Navashin's in both Haidenhain's and Newton's iodine gentian violet. The Feulgen test according to the schedule of Johansen (1940) was done in the flower bud sections of *J. betonica.* Aceto-carmine smears were also attempted but were not very successful. Sketches were drawn with the help of the camera lucida at different magnifications.

## *Observations*

*Anther-structure*: The anther is two-celled and four-lobed in the three species. In *B. prinotis* and *R. tuberosa* the cells are parallel, but in *J. betonica* the cells are superposed with the lower one tailed. The superposition of the anther cells appears to be the result of the oblique development of the connective (Fig. 1). The anther-wall excluding the tapetum is three-layered (Figs. 2 and 3), the innermost layer consisting of small and narrow cells. There is a peculiarity of the wall in *J. betonica.* It is protruded into the loculi on the inner side at the middle (Figs. 1 & 2). This feature is present in another species of the family, *Astercantha longifolia* (Narayanan, unpublished), although the anther-cells in this species as in *B. prionotis* and *R. tuberosa* are parallel and not superposed. There is no endothecium in the generally accepted sense of the term in any of the species under study, although the dehiscence of the anther is longitudinal. The tapetum which exhibits certain peculiarities in *J. betonica,* lies next to the innermost wall layer (Figs. 2, 3, 40 & 41). The pollen-mother-cells (P.M.Cs) are uniseriate in all the three species. Here and there in *J. betonica* they are two-seriate (Fig. 2). In number, the P. M. Cs. are relatively more numerous in *J. betonica* than in the other two species (Figs. 2 & 40).

*Microsporogenesis*: The nucleus of the P. M. Cs. is prochromosomal as in the root tip nuclei of these and several other species of the family (Narayanan, 1952). Figs. 4 & 42 represent the resting nuclei of *J. betonica* and *B. prionotis* respectively. The nucleus is large and the prochromosomes are peripheral in distribution, so that it was difficult to count their exact number, which, however, approximates the somatic number ($2n = 28$) in *J. betonica.* In *B. prionotis,* the prochromosomes exhibit chromomere structure looking like miniature *Nostoc* filaments (Fig. 42). While in *J. betonica* meiosis starts with the rounding off of the P. M. Cs. in *B. prionotis* it is the protoplasts that round off from the wall of the enlarged *P.M.Cs.*

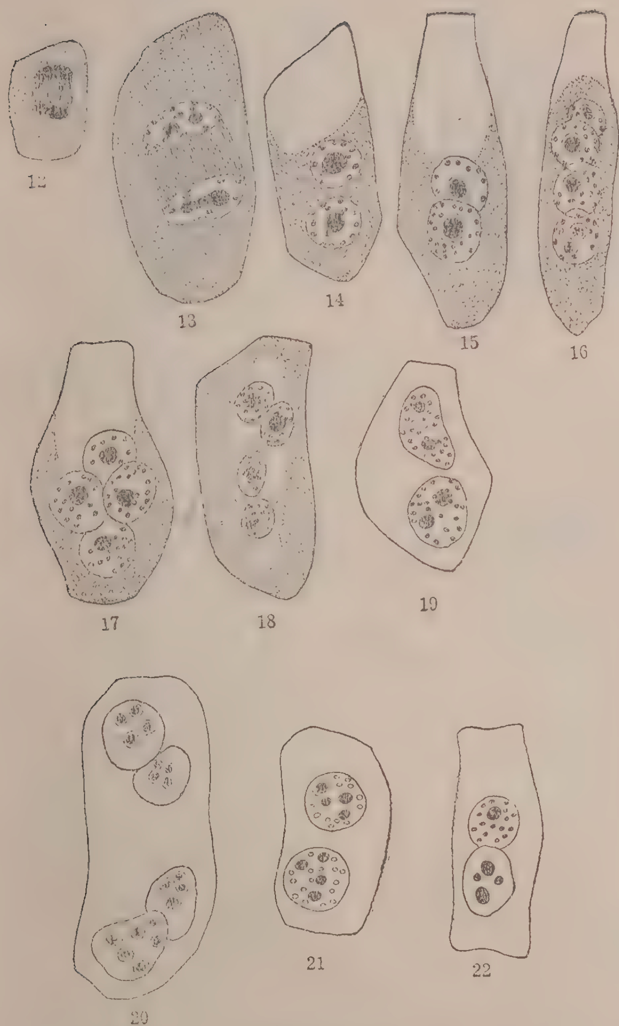


FIGS. 1-11

FIGS. 1-39. Meiosis in *Justicia betonica*

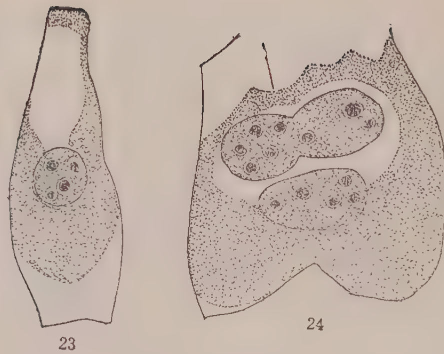
1. T. S. of anther (× 125). 2. T. S. of anther loculus (× 250). 3. A part of one another loculus in the pachytene stage of the P.M.Cs. (× 500) showing intrusive tapetum on one side and ordinary tapetum on the other. 4. Resting nucleus of a P.M.C. with promochromosomes. 5. Zygotene. 6. Pachytene with bouquet. 7. Metaphase I in polar view. 8. Metaphase II in polar view. 9. Early telophase II. 10. Later telophase with four daughter nuclei and prochromosomes. 11. Pollen tetrad.

(Fig. 41). This cannot be an artifact because it is observed consistently in all the stages of meiosis. Figs. 5 & 43 presumably represent the zygotene in *J. betonica* and *B. prionotis* respectively, judging from the presence of 14 bivalents in Fig. 5 and 15 in Fig. 43. The pachytene stage is of interest in showing bouquet arrangement of the pachytene threads in relation with the nucleolus in all the three species (Figs. 6, 44 & 67). A disturbance from the bouquet arrangement is observed in some of the P. M. Cs. in *B. prionotis* (Figs. 45 and 46). In Fig. 45 while two bivalents are seen attached to the nucleolus, the remaining are free from the latter. Chromosome entanglements with the figure of eight (Fig. 46) are observed in some of the P. M.Cs. Another form of pachytene entanglement is represented in Fig. 47. Diakinesis was observed only in the case of *B. prionotis* (Figs 48 & 54), however in many P.M.Cs. The bivalents are peripheral in distribution but the occurrence of similar bivalents associated together is also obvious. This behaviour of the bivalents was observed in most of about 25 cases examined of which 7 have been figured. Figs. 7, 26-36, 55-59, 70-81 represent metaphase I in polar view in the three species, with 14 bivalents in *J. betonica,* 15 in *B. prionotis* and 16 in *R. tuberosa.* In *R. tuberosa* in two of the P.M.Cs., 17 bivalents are observed (Figs. 80 & 81). Such a discrepancy is also observed in *B. prionotis* (Figs. 57 & 58). Getting good metaphase plates was of considerable difficulty in *B. prionotis,* although over hundred flower-buds were sectioned. The clumping of the chromosomes which is generally attributed to bad fixation appears as a common feature. An obvious feature of the metaphase figures in the three species is the uneven distribution of the bivalents clearly suggestive of secondary pairing. Metaphase II in *J. betonica* observed in more than one case is shown in Figs. 37 & 38, and that in *B. prionotis* in Fig. 60. Fig. 9 is the early telophase II and Fig. 10 is the later telophase II of *J. betonica.* Figs. 62-64 represent later telophase II of *B. prinotis* and Figs. 68 & 69 that of *R. tuberosa* respectively. The nucleolus and the prochromosomes appear in the same fashion as in the root-tip mitosis of many of the species of the Acanthaceae (Narayanan, 1952). In the case of *R. tuberosa* (Figs. 68 & 69) in the P.M.C. figured the number of prochromosomes in each nucleolus exceeds the number of bivalents or the haploid number ($n = 16$). Whether this is an evidence of increased polyploidy by failure of reduction division is not clear. Cytokinesis is of the usual type by furrowing from the periphery of the P.M.C. In *B. prionotis* the process of vacuolation of the cytoplasm leading to its division (Sharp, 1938) is also observed. The



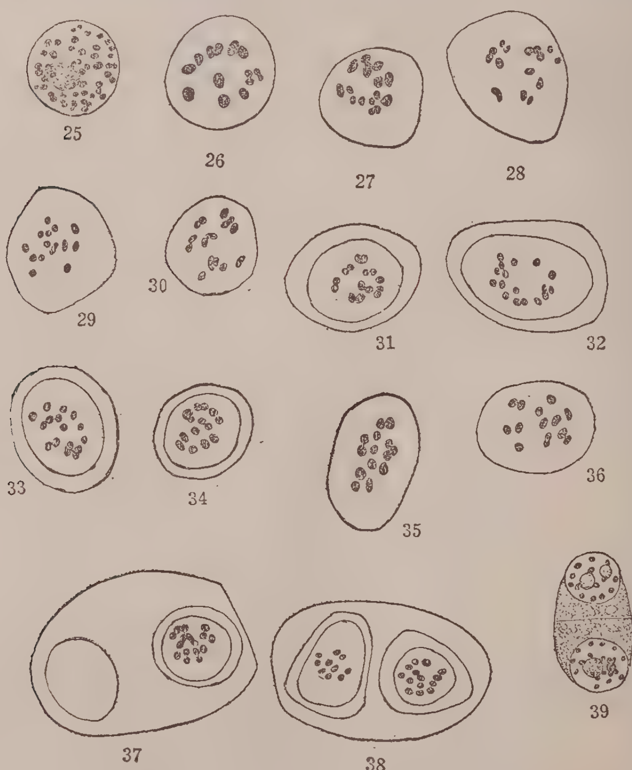

Figs. 12-22

12-22. *Intrustive tapetal cells and nuclei.* 12. Early telophase of first motosis. 13. Later telophase. 14 and 15. Binucleate tapetal cells. 16. Quadrinucleate tapetal cell. 17 and 18. Quadrinucleate tapetal cells showing the apposition of the nuclei following the vacuolation of the cytoplasm. 19. A tapetal cell with two fusion nuclei. 20. An enlarged tapetal cell with four large nuclei in pairs, with no prochromosomes and many nucleoli. 21. A tapetal cell with two nuclei in each of which there are four nucleoli and lightly chromatic prochromosomes. 22. A tapetal cell with two nuclei, one with one nucleolus and prochromosomes and the other with four nucleoli and no prochromosomes.



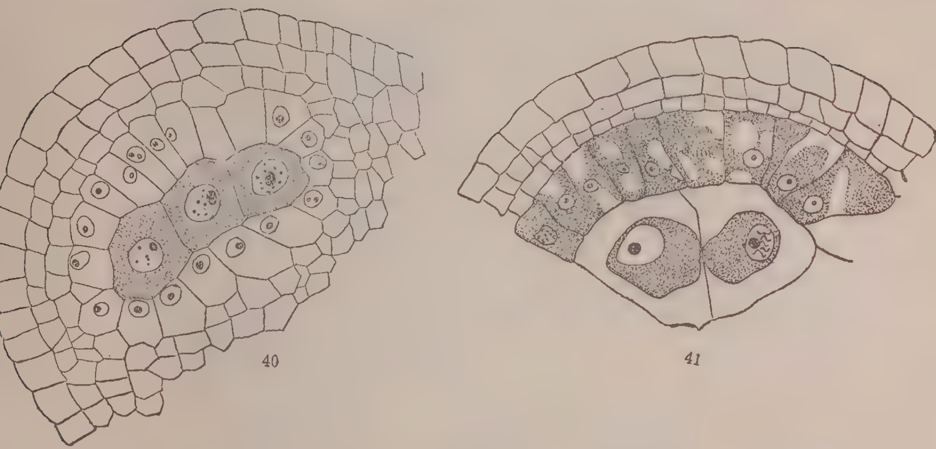

Figs. 23 and 24

23. An enlarged tapetal cell with one nucleus with four nucleoli and no prochromosomes. 24. A syntapetal cell with two fusion nuclei each with many nucleoli and no prochromosomes.




Figs. 25-39

25. Nucleus of a P.M.C. with fragmented chromosomes. 26-36. Metaphase I in polar view in different P.M.Cs. 37 and 38. Metaphase II in polar view. 39. Late telophase of mitosis in a root-tip cell in lateral view. Figures 4-39 magnified by 1000 diameters.



40

41

FIGS. 40-41

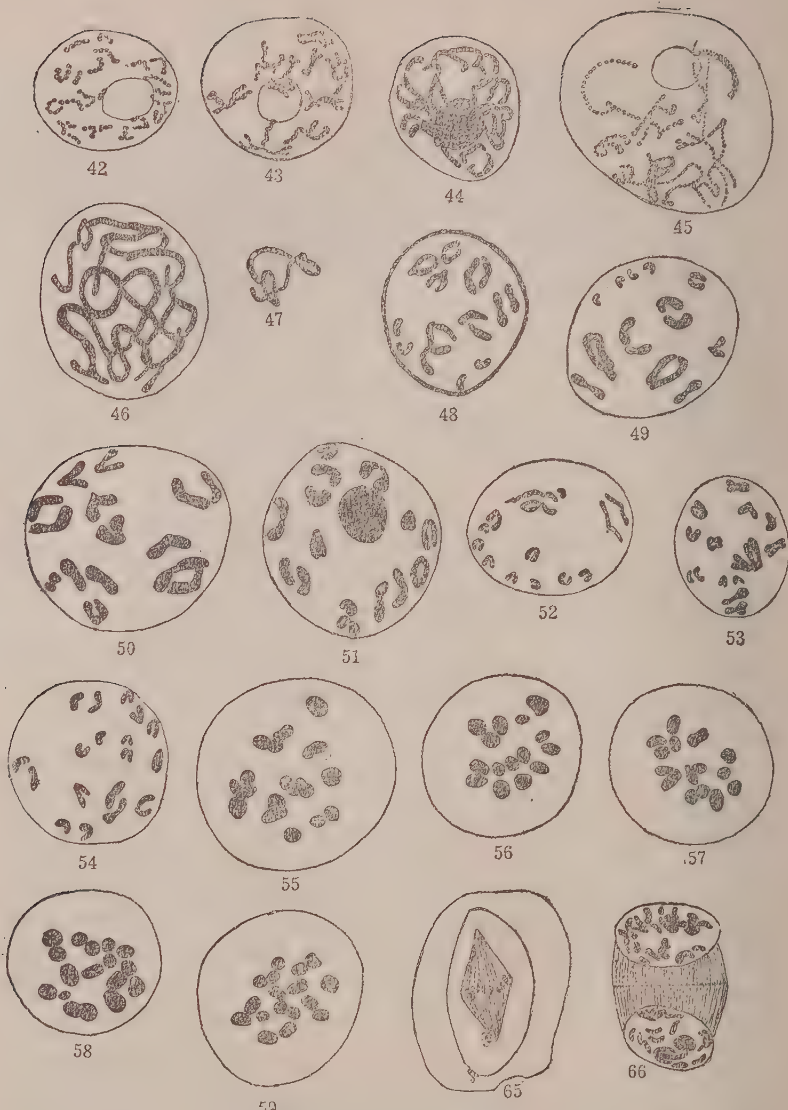
FIGS. 40-65 Meiosis in *Barleria Prionotis*

40. T.S. of anther loculus with one series of three P.M.Cs. with resting nuclei (× 250). 41. T.S. of anther loculus with P.M.Cs. in the pachytene stage with rounded off protoplasts (× 250).

tetrads are both tetradedral and cruciform (Figs. 61 & 63). Dyads are also not infrequent, showing the omission of the second division (Fig. 64).

*Meiotic abnormalities*: Fragmentation during anaphase I has been already noted in *B. prionotis* (Narayanan, 1952). Extrusion of chromosomes or fragments in metaphase I is observed in the same species (Fig. 65). One chromosome surrounded by a vacuole lies outside the spindle and another in the cytoplasm. In *J. betonica* in sections of one flower-bud, presumably in the pachytene stage of meiosis, numerous chromatic bodies surrounding a lightly stained nucleolus are found in the place of the chromosome threads (Fig. 25). This may be indicative of the break-down of meiosis.

*The tapetum*: This is of the glandular type (Maheshwari, 1950) in all the three species. In *B. prionotis* (Figs. 40 & 41) the tapetal cells enlarge radially, and before the pollen-grain stage is reached become flattened tangentially. In *J. betonica* the tapetum which is uniform in the young anther becomes specialized in the maturing anther (Figs. 2 & 3). The tapetal cells in the outer side enlarge only to a limited extent; those on the inner side applied to the bulge of the anther-wall enlarge much radially, so as to protrude conspicuously into the loculus (Fig. 3). The latter cells are mostly



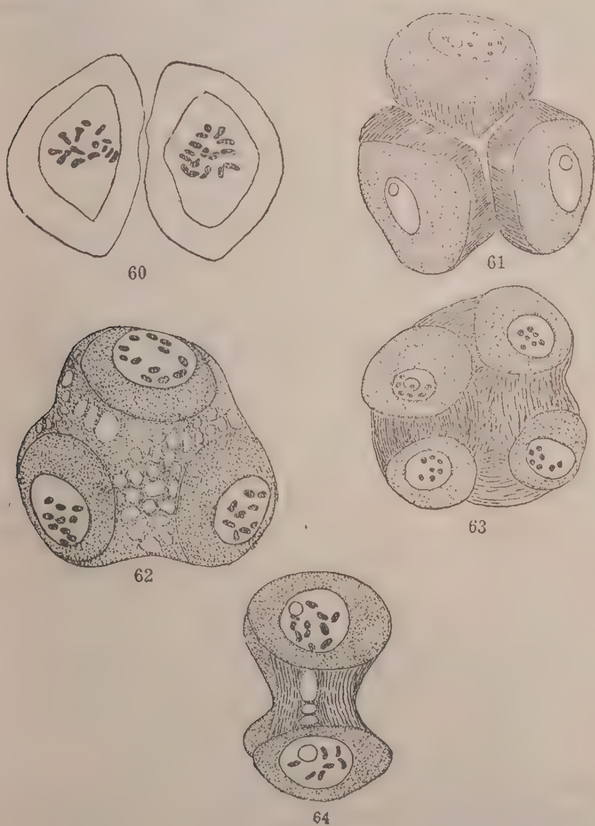

FIGS. 42-59, 65 and 66

42. Resting nucleus of a P.M.C. with prochromosomes (× 250). 43. Zygotene. 44. Pachytene with bouquet. 45. Pachytene without bouquet. 46. Pachytene with the Figure of eight. 47. A pair of entangled pachytene threads. 48-54. Diakinesis in different P.M.Cs. 55-59. Metaphase I in polar view in different P.M.Cs.

65. Meiotic abnormality (× 750, see text). 66. Mitotic telophase in a root-tip cell of *B. prionotis*. All sketches from 43-66 except 65 magnified by 1100 diameters.

quadrinucleate while the outer tapetal cells are binucleate or here and there trinucleate. Lateral separation, accompanied by a vacuolation of the cytoplasm overtake the intrusive tapetal cells as microsporogenesis progresses. In some flower-bud sections, the inner tapetal cells collapse in the maturing anther, but in some others the entire tapetum persists even in the pollen grain stage of the anther, although the cells are denuded of cytoplasm but retaining their nuclei.

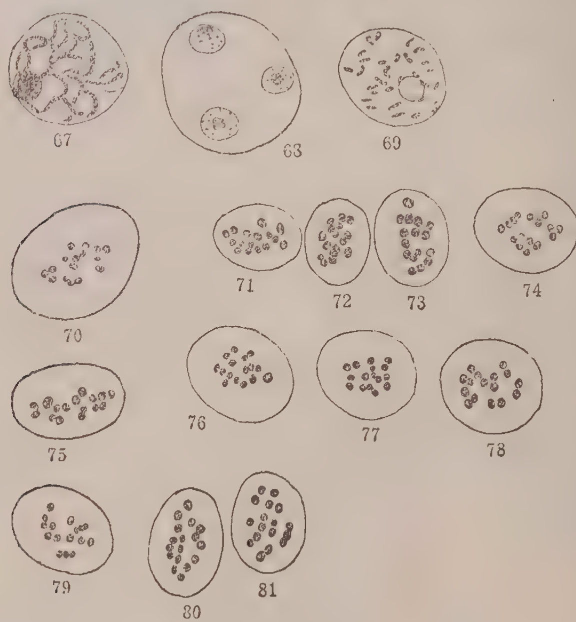
Nuclear studies were made in the tapetal cells of the intrusive type. As in the P.M.Cs., the tapetal nuclei are prochromosomal and the divisions are mitotic. Some of the stages of the first division




FIGS. 60-64

60. Metaphase II in polar view. 61. Tetrad formation of the usual type. 62. Tetrad formation by vacuoles. 63. A cruciform tetrad. 64. A dyad.

have been figured (Figs. 12 & 13). The second division is presumably mitotic, but the stages could not be followed as it perhaps occurs too quickly. The four nuclei differ in size and arrangement in the different tapetal cells (Figs. 16-18), and each is distinguished by a large nucleolus and peripheral prochromosomes. Certain abnormalities were worth noting and so have been recorded and figured. Nuclear fusions have been observed in many tapetal cells. The fusion which takes place in pairs, is brought about by the vacuolation of the cytoplasm causing the movement of the nuclei (Figs. 15, 17 & 18). In Fig. 18 the nuclei appear in opposition prior to fusion and in Fig. 19 the union is complete which could be judged by the larger size of the two nuclei and each having two nucleoli and more prochromosomes. Fig. 23 represents an enlarged tapetal cell with a single large nucleus with four nucleoli, suggestive of the union of all the four nucleoli. A significant feature in the example




Figs. 67-81 Meiosis in *R. tuberosa*

67. Pachytene bouquet in a P.M.C. 68. Late telophase in a P.M.C. with three nuclei, each with a nucleolus and prochromosomes, (× 325). 69. One nucleus of Fig. 68 enlarged with more than the haploid number of prochromosomes. 70-81. Metaphase I in polar view of different P.M.Cs. All figures except 68 magnified by 1100 diameters.

is the absence of prochromosomes. Fig. 24 represents the union of two enlarged tapetal cells, accompanied by the union of their nuclei. These cells occurred in the same flower-bud sections, containing four-nucleate cells. The number of nuclei involved in union may be taken as eight. The two resulting fusion nuclei are large and as in the previous case (Fig. 23) no prochromosomes are visible, but the number of nucleoli is multiplied. Some other abnormalities are illustrated by Figs. 20-22. Fig. 20 is that of an enlarged tapetal cell with four enlarged nuclei occurring in pairs, perhaps prior to fusion. In all the nuclei the prochromosomes are absent, but the number of nucleoli is multiple. In Fig. 21 in each of the two nuclei the prochromosomes are in the stage of losing their chromaticity and the number of nucleoli is four. Lastly as in Fig. 22 of the two nuclei, in one, there is one nucleolus and definite chromatic prochromosomes, while in the other, there are four nucleoli but no prochromosomes.

## *Discussion*

*Anther-structure*: Two significant features of the anther-structure of the three species studied are, the non-development of the endothecium, if by this is understood the outermost wall-layer with fibrous thickenings and the intrusion of the anther-wall in *J. betonica* (Figs. 2 and 3) at the inner sides of the anther loculi. As regards the first, the present examples may belong to the category of exceptions in anther-structure mentioned by Maheshwari (1950). As regards the second feature there is striking correspondence with *Salvia mellifera*, a species of Labiatae as figured by Carlson and Stewart (1936). Taxonomically the two families Acanthaceae and Labiatae are placed in different cohorts by Bentham and Hooker, and in different orders although fairly separated by Rendle (1952). Similarities do exist between the families and it might be that this feature is another such. It must be noted however, that such anther-structure is not characteristic of the family Acanthaceae, for though it is present in *Astercantha longifolia*, it is absent in *B. prionotis* and *R. tuberosa*.

*The Tapetum*: This appears in *J. betonica* to belong to the uncommon type (Maheshwari, 1950). In its specialisation into two zones it resembles exactly that figured in *Salvia mellifera* (Carlson and Stewart, 1936), which again raises a question of taxonomic relationship of the two. A somewhat similar differentia-

tion of the tapetal cells has also been recorded *Lathraea* (Gates & Latter, 1927), in *Ranunculus scleratus* Linn (Singh, 1936), and in *Moringa* (Puri, 1941). There can be no doubt that the intrusive tapetal cells are more specialised in comparison with the rest of tapetum, considering their elongation into the anther cavity and the abnormalities exhibited by them in many cases.

The nuclear abnormalities recorded here appear to belong to a different category from those recorded in other plants (Gates & Rees, 1921, in *Lactuca*, Cooper, 1933, in *Podophyllum, peltatum*, Bhargava, 1936, in *Chenopodium album* Linn., Raghavan, 1938, in *Gynandropsis pentaphylla*, Venkatasubban, 1944, in *Cresentia cujete* and Witkus, 1945, in *Spinacea oleracea*). In some cases the union of the nuclei in the same cell (Fig. 23) or between adjacent cells (Fig. 24) is accompanied by the invisibilty of the prochromsomes and the multiplication of the nucleoli. In some (Fig. 21) though the nuclei remain separate the prochromosomes appear to lose their chromaticity and the number of nucleoli becomes multiple. Again as in Fig. 22, of the two nuclei, in one, there is one nucleolus and several prochromosomes, but in the other no prochromosomes and four nucleoli. Lastly as in Fig. 20 in each of the four nuclei which are relatively enlarged, the absence of prochromosomes and the increase of nucleoli to as many as six is significant. Gates and Rees (1921) have described in the tapetal nuclei of *Lactuca* the appearance of numerous chromatic bodies outside the chromatin network. Bhargava (1936) has observed and figured in *Chenopodium album*, secondary nuclei resulting out of fusion of tapetal nuclei with multiplicity of the nucleoli but the chromatin network is also clearly evident in such fusion nuclei. Raghavan (1938), in *Gynandropsis pentaphylla* has recorded not only nuclear fusions in the tapetal cells but also the merging of the nucleoli with the prochromosomes. In all the three examples cited above the tapetum is of the amoeboid type. In *Cresentia cujete* (Venkatasubban, 1944) another prochromosomal plant, though the union of the nuclei takes place in the tapetal cells which are of the glandular type, the nucleoli and the prochromosomes retain their individuality.

In the present example of *J. betonica*, the abnormalities recorded in the tapetal nuclei, appear to indicate the interchangeability of nuclear and chromosomal materials. Otherwise it is difficult to account for the increase in the number of nucleoli which is accompanied by the loss in the chromaticity of the prochromosomes and

their complete invisibility (Figs. 21, 23 & 24). It looks as if such a phenomenon may take place with the fusion of nuclei (Fig. 24) or without their fusion (Figs. 20 & 22). It may be mentioned, that in destaining the flower-bud sections with both Haidenhain's and Newton's iodine gentian violet, differentiation in the tapetal nuclei takes place later than in the P.M.Cs. In the Feulgen test (to which the prochromosomes and the chromosomes are positive and the nucleolus negative) the staining of the chromatic bodies was deeper in the tapetal nuclei than in those of the P.M.Cs. This may be proof of the higher chromatin content of the tapetal nuclei and the increase in the number of nucleoli a measure of their higher metabolic activity. This interpretation is based on the present concept regarding the chromosomal material or DNA and nucleolar substance or RNA.

*Meiosis and secondary pairing*: In *J. betonica*, except for secondary pairing, meiosis appears straightforward. In *R. tuberosa*, the occurrence of 16 bivalents in ten out of the twelve metaphase plates (Figs. 70-79) and 17 bivalents in the remaining two (Figs. 80 & 81) is consistent with the previous observations on the somatic chromosomes of the species. Thus, according to Sugiura (1936) $2n = 32$ and according to Bowden (1940) $2n = 34$. It is not surprising therefore to meet with 16 and 17 bivalents in different P.M.Cs., of the same species.

In the case of *B. prionotis*, meiosis is a more interesting phenomenon. The looping and interlocking of the pachytene threads with the appearance of the figure of eight in some of the P.M.Cs. (Figs. 46 & 47) suggests that meiosis is not straightforward in the species. Of course, further detailed studies are required to reconstruct the significance of such meiotic phenomena. There is again discrepancy in the number of chromosomes in diakinesis and metaphase I noted in the different P.M.Cs. In 25 P.M.Cs. in which diakinesis was observed of which seven have been represented here (Figs. 48-54) the number of bivalents in 19 cases is 15. In three, the number is 16 (Fig. 52); in two the number 18 (Fig. 54); and in one the number is as many as 19. In some at least as in Fig. 52 what look like univalents are observable. Similarly in metaphase I out of the five plates represented (Figs. 55-59) in three (Figs. 55-57) the number of bivalents is 15. In one (Fig. 58) there are 16 figured of which one which is the smallest is outside the level of the others, although it has been drawn in the same shade as the rest. Omitting this, there are only 15 bivalents. In Fig. 59 there are 17 bodies looking like apparent bivalents.

These discrepancies of chromosome number have to be related to the prevalence of aneuploidy not only in the family Acanthaceae but also in the genus *Barleria*, previously recorded (Narayanan, 1952). In *B. prionotis* the chromosome number of the root-tip has been recorded as 30, of which 18 are larger and 12 smaller. Disparity in chromosome sizes in other species of the genus has also been recorded and in one variable species *B. cristata*, different chromosome numbers are met with (Narayanan, 1952). Both fragmentation and duplication of the chromosomes have been adduced as the cause of the disparate chromosome numbers and disparate chromosome sizes in the genus *Barleria* and also in the family Acanthaceae. Fragmentation during anaphase I of meiosis has been observed in *B. prionotis* (Narayanan, 1952). The extrusion of chromosomes outside the spindle is also seen in the same species (Fig. 65). The loss of chromosomes into the cytoplasm during root-tip mitosis has also been recorded in *Acanthus ilicifolius* and *Asystasia coromandeliana* (Narayanan, 1952), in which disparate chromosome numbers are found in cells of the same root-tip. One is likely to find in the light of the observations recorded above, disparate chromosome numbers in the root-tip mitosis of *B. prionotis*

*Secondary pairing*: This phenomenon has been recorded in several species of dicot and monocot families of the angiosperms. In the Acanthaceae it appears to have been noted so far in one species *Asteracantha longifolia* (Rangaswamy, cited by Venkatasubban, 1944), where n=16. According Suguira (cited in the *Chromosome Atlas* of Darlington and Janaki Ammal, 1945) 2n = 24 in this species.

In *J. betonica*, in the eleven plates of metaphase I (Figs. 26-36) and the two plates of metaphase II (Figs. 37 & 38) the uneven spacing of the chromosomes is obvious. There is however no uniformity in the different cases figured. In some (Figs. 26 & 31) many of the bivalents are in pairs. In two at least (Figs. 27 & 28) there is an association of three bivalents in each, the others occurring in pairs or singly. In one Fig. 32 one could observe an association of four bivalents. A uniform feature of the first metaphase figured in all the cases is the pairing of the bivalents similar in size.

In *R. tuberosa* (Figs. 70-81) there is no disparity in the size of the bivalents, and their paired condition varies in the eleven cases figured. The association of three bivalents (Figs. 70, 71, 74, 79 & 81) seems to be more frequent. An association of four bivalents is apparent as in Figs. 73, 80 & 81, unless one considers the four bival-

ents as two separate entities. The occurrence of bivalents in pairs in all the examples figured is also obvious.

*B. prionotis* is most favourable for the study of the secondary pairing because of the relatively larger chromosomes and also of the occurrence of diakinesis stages in several P.M.Cs. Again, one can observe clearly that the association is between the bivalents of the same size and type (Figs. 55-59).

If by secondary pairing is understood the approximation of chromosomes similar in size and shape appearing first at metaphase I variable in occurrence from division to division (Darlington, 1938) then the phenomenon is most clearly indicated in *B. prionotis*. Here also as in the other two species the bivalents are associated in twos and threes as the five text figures show.

It is now established that secondary pairing in meiosis is an indication of allopolyploidy while multivalent association is a proof autopolyploidy (Lawrence, 1931). On this basis the three species of the Acanthaceae must be recorded as allopolyploids. It is from the phenomenon of secondary pairing that the basic chromosome number of species or plant-groups is derived. The data available in connection with the examples is not however sufficient to warrant such an investigation.

One cannot resist judging from the figures of diakinesis (Figs. 48-54), and metaphase I (Figs. 55-58) in the case of *B. prionotis* to draw certain conclusions relating to the two phenomenon of meiosis in this species. According to Darlington (1938), secondary pairing commences only at the end of diakinesis. According to Lawrence (1931) diakenisis is a repulsion phase which is fully maintained until mid-diakinesis. The degree of repulsion gradually diminishes and diakinesis is abruptly terminated by the sudden converging of the chromosomes on the centre of the nucleus. This stage (pro-metaphase) is very brief and characterized by a secondary association of a number of chromosomes. Catcheside (1937) concludes from his observations of secondary pairing in *Brassica oleracea,* that it is solely dependent upon diakinesis positions of the bivalents relating to one another, and therefore all bivalents which lie adjacent at diakinesis and which are capable of pairing are also paired at the metaphase I. The view of Heilborn (1936 & 1937) upon the problem of secondary pairing is, the phenomenon is present throughout the prophase of meiosis and becomes accentuated at metaphase I, and the paired condition is between chromosomes

of the same sizes. The diakinesis figures of *B. prionotis* (Figs. 48-54) appear in support of the observation of Catcheside and Heilborn. The bivalents are no doubt peripheral in distribution in the nuclei, some retaining their nucleoli and others not. The juxtaposition or proximity of the bivalents of similar sizes is very obvious. It does not appear fortutious that in all the nuclei the bivalents are approximated according to their sizes. That secondary pairing in metaphase I seems to be the continuation of the pairing in diakinesis is apparent from the figures recorded.

*Nucleolus and Ploidy*: It is generally conceded that the number of nucleoli appearing at telophase of nuclear divisions will be equal to the number of gametic sets of chromosomes in the nucleus, and that there are nucleolar or sat-chromosomes concerned in the organisation of nucleoli, one in a haploid, two in a diploid, three in a triploid, four in tetraploid and so on. Barring exceptions due to disturbance in the genotypic control (Matsuara, 1938) or due to segmental interchanges between nucleolar and non-nucleolar chromosomes (Bhaduri, 1942), resulting in more than the usual number of nucleoli the relation between ploidy and the number of nucleoli appears to hold good in many cases. If the present species are considered as allopolyploids on the basis of secondary pairing, one should expect two nucleoli in meiotic telophase I and four in mitotic telophase. An extensive study of the root-tip mitosis of both *J. betonica* (Fig. 39) and *B. prionotis* (Fig. 65) shows that there are only two nucleoli in the telophase of each species. In the mitosis of the tapetal nuclei of *J. betonica* there are again only two nucleoli occuring in telophase (Fig. 13). Evidence from the number of nucleolar chromosomes is also unconvincing. Though in some of the tapetal nuclei of *J. betonica* (Figs. 13 & 14) one prochromosome is found associated with each nucleolus, in the root-tip mitosis of the same species, the number of prochromosomes associated with the nucleoli in telophase is not definite. (Fig. 39). The crowding of many prochromosomes in the mitotic telophase of *Polanisia trachysperma* has been figured by Raghavan (1938). It has been observed by Manton (1935) and Vanderlyn (1948) in his review, that in prochromosomal plants, all the chromosomes take part in nucleolar formation by the emission of a substance from the terminal regions. Such a possibility has also been noted in the study of the root-tip mitosis of many species of the Acanthaceae (Narayanan, 1952). In such a case, there does not seem to be any connection between ploidy and the number of nucleoli in such plants.

## Summary

Microsporogenesis has been described in three species belonging to divergent genera of the Acanthaceae.

Secondary association of the chromosomes has been noted in all the three species, on the basis of which they have been interpreted as allopolyploids. The basic chromosome number however was not possible to be fixed owing to want of sufficient data and also variability in the chromosomal associations.

In the case of *Barleria prionotis* there is secondary pairing of bivalents of similar sizes even in diakinesis so as to suggest that secondary pairing in metaphase I is the continuation of diakinesis pairing.

There does not appear to be distinct connection between ploidy and the number of nucleoli as evidenced from root-tip mitosis of the two species *Justicia betonica* and *Barleria prionotis.*

Chromosome entanglements and extrusion of chromosomes have been noted in the meiosis of *Barleria prionotis.*

Certain abnormalities in the tapetal nuclei of *Justicia betonica* appear to suggest the direct interchangeability of chromosomal and nucleolar substances.



## Acknowledgment

The author is deeply indebted to Dr. K. R. Venkatasubban of the Christian College, Tambaram, for having suggested the Acanthaceae for cytological study and for many useful suggestions.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# Petrofabric Analysis of the Rocks of the Charnockite —Dunite Area of Salem

BY

S. RAMANATHAN

*Department of Geology and Geophysics, University of Madras, Madras-25*

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ABSTRACT

The microfabrics of twelve rock types from Salem were studied and nineteen petrofabric diagrams prepared and interpreted. Their relationship to the metamorphic history of the area is discussed.

*Introduction*

In recent years, considerable work has been done on the petrofabric analysis of rocks. From the petrofabric diagrams thus prepared, conclusions have been drawn on various aspects of metamorphic geology. Ingerson (1936) has analysed a coarsely crystalline polymetamorphic tectonite from Nidarthal and has recognized in the Alps, a B-oblique-B'-tectonite and has been able to establish the relative ages of the shear planes found in the rock. Phillips (1937) has analysed the fabric of the Moine schists and concludes that the Moine schists are of pre-Caledonian age. The same author, in 1938, has analysed olivine-rich rocks of Rum and Skye and has shown that the dunite there has suffered metamorphism resulting in a preferred orientation of olivine. Again Phillips (1939), analysing the microfabric of the Tarskavaig-Moine series, has established that the Moine rocks are of pre-Torridonian age and that the Tarskavaig-Moine series are the sheared representatives of the above. Turner (1940), working on the Otago schists of New Zealand has drawn the relative ages of the shear-planes and the presence of lineations of two ages. Cameron (1945) working on the grey granites of Aberdeenshire, has shown the relationship of the parallelism of some minerals to the joints of the rocks. Knopf (1949) has studied the deformation of the Yule marbles and their relation to experimental data. McIntyre (1951) has studied the tectonics of the area between Grantown and Tomintoul and has established that the Moine and the Dalradian suffered the same

movement. Balk (1952) working on the fabric of Quartzites near thrust faults, is of opinion that a-lineation characterizes the quartz fabric near thrusts. McIntyre and Turner (1953) working on the marbles of Mid-Strathspye and Strathavon have indicated that the preferred orientations of Calcites conform to the regional trend of foliation, lineation and fold axis and that the twinning in calcite is an expression of minor post-crystalline deformation.

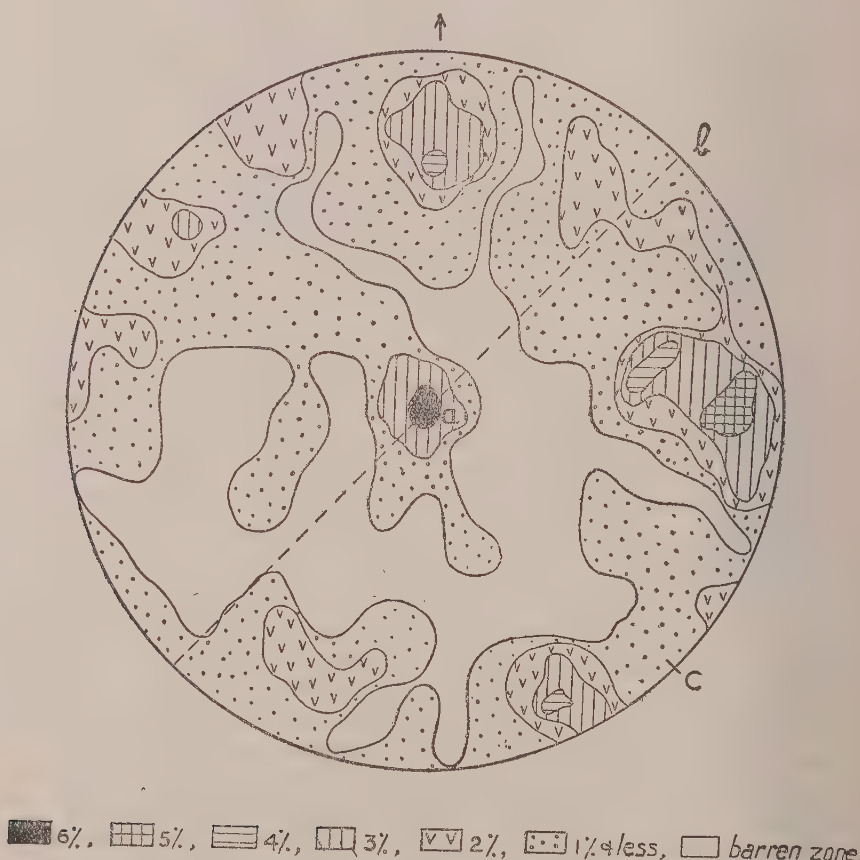



FIG. 1
Quartz diagram of leptite from the middle of ultrabasic mass, Salem, S. 9.

The charnockite-dunite area of Salem has been studied by the author from various aspects. A geological map of the area has been published (Ramanathan, 1956) and the major tectonic features have been indicated in that map. A series of specimens of rocks,

oriented in the field, were collected and petrofabric diagrams were prepared of them. The diagrams prepared are of the minerals Quartz, enstatite, olivine, biotite and augite. The sections were all cut perpendicular to the foliation. The poles are plotted in a Schmidt net and the petrofabric diagrams are of the lower hemisphere. In some cases where there was no visible foliation, the specimens were orientated with reference to a neighbouring foliated rock. The localities of the specimens are indicated in Map 1. Descriptions of diagrams follow.

### *Quartz diagrams*

Fig. 1 is that of a leptite (S. 9) with biotite as the mafic mineral taken from the middle of the ultrabasic mass. On weathered surfaces, it shows a faint foliation, though on fresh surfaces, this is not clear. The foliation is indicated by the flakes of mica present. Under the microscope, it shows clear and Kaolinised bands; the clear bands being those of Quartz and the Kaolinised being those of plagioclase. The rock shows distinct gneissosity. The Quartz is mylonitised, shows undulose extinction and has an elongation ratio, nearly 1 : 10. The foliation is 43° to the east of north.

Fig. 1 shows a maxima in the centre with a girdle in which lie a series of minor maxima. This maximum corresponds to maximum I of Sander (1950), which he interprets as the a-direction of transport. It is therefore a B-tectonite. It has also got an incipient cross-girdle.

Fig. 2 is that of a charnockite (intermediate type; S. 10) from the middle of the ultrabasic mass. The rock is grey in colour and granitic in texture with no visible foliation at all. It was oriented in the field with reference to the foliation of the neighbouring leptite (S. 9). The Quartz grains are distinctly elongated, the elongation ratio being about 1 : 7. The hypersthene grains also have a parallelism roughly to that of Quartz. The foliation is roughly 30° to the north of west.

This diagram also shows maximum I in the centre, a b-c girdle and several minor maxima distributed in it. It has also got an incipient cross-girdle. This is also a B-tectonite with maximum I as a-direction of transport.

The two diagrams, Figs. 1 and 2, are identical showing that the leptite and intermediate charnockite have suffered the same deformational movement.


Fig. 2

Quartz diagram of charnockite from the middle of the Ultrabasic mass, Salem, S. 10.

Fig. 3 is of a charnockite (intermediate type; S. 13) from Kusamalai. In hand specimen, there is a very faint banding visible and salic and femic minerals are irregularly concentrated into bands. This was taken to be the foliation and the section was cut perpendicular to this direction. The Quartz shows undulose extinction and some grains show an elongation ratio upto 1 : 7, but they are mostly equant. The hypersthene grains also shcw parallelism concordant with that of Quartz. The foliation is roughly N-S.


FIG. 3

Quartz diagram of intermediate charnockite from Kusamalai, Salem, S. 13.

The diagram shows again a maximum in the centre corresponding to I of Sander (op. cit.) and three other maxima along the peripheral girdle indicating that there is not much of preferred orientation in this rock. There is, however, a well-developed cross-girdle. This would constitute a B $\perp$ B'-tectonite.

Fig. 4 is that of a perfectly foliated biotite gneiss (S. 84) the foliae being emphasized by the parallel orientation of biotite flakes. The biotite tends to aggregate in clots, but these clots have a rough parallelism which coincides with that of the elongated Quartz

grains. The elongation ratio of Quartz is from 1 : 3 to 1 : 5. The foliation is roughly 26° to the east of north.

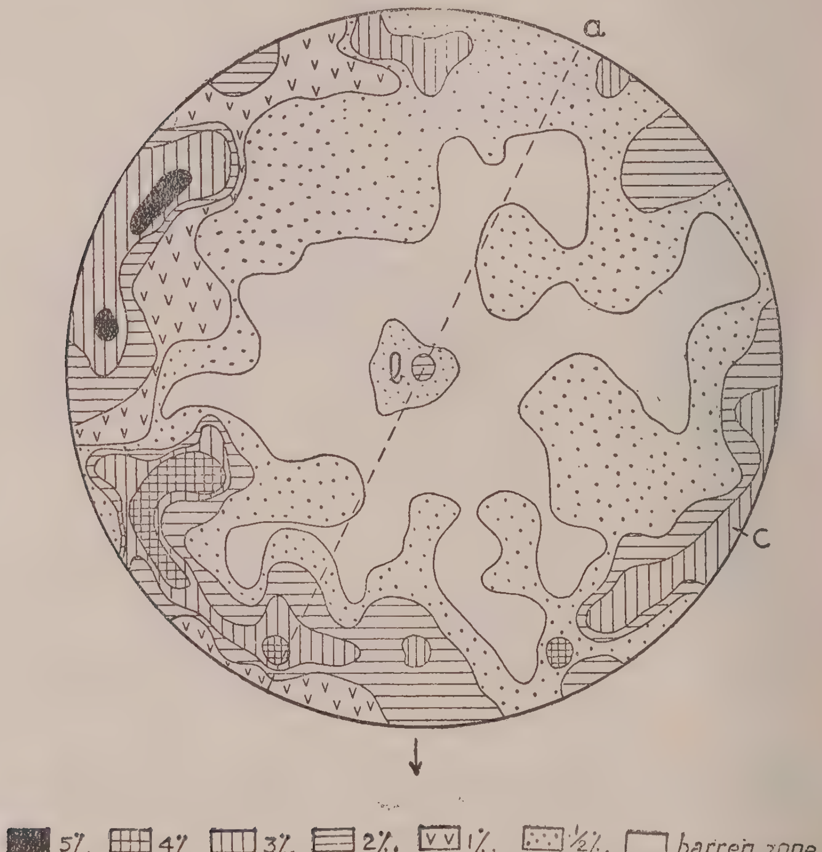



FIG. 4

Quartz diagram of biotite-gneiss showing perfect foliation, Salem, S. 84.

The Quartz diagram of this rock shows a maximum, in the position of maximum IV of sander. The maximum of this diagram corresponds to the biotite maximum. (Fig. 10). This is also a B-tectonite with a well-developed girdle.

Fig. 5 is that of a leptynite (S. 45) from Shervaroys. The specimen has a faint foliation. The garnet in this rock is in places converted to biotite. Such biotite flakes have no orientation. The Quartzes have a very large elongation ratio, 1 : 10; there are grains

from porphyritic to mylonitised tiny grains of Quartz. All these have been measured. The foliation is roughly N-S.

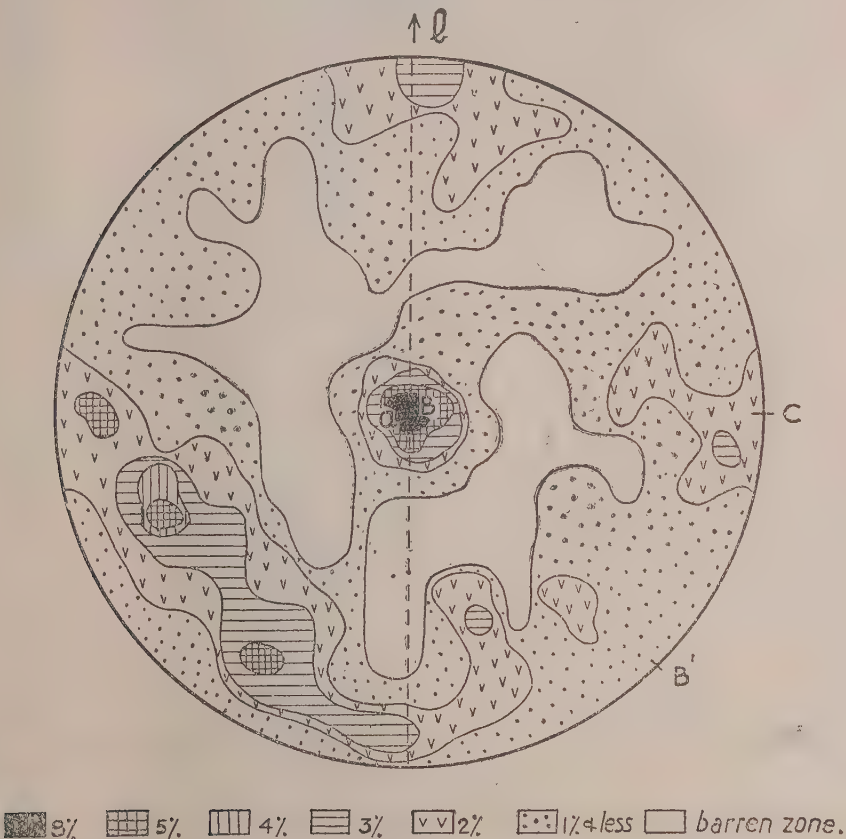



FIG. 5

Quartz diagram of leptynite, from Shervaroys, Salem, S. 45.

This diagram shows maximum I in the centre indicating a direction of transport, a girdle and minor maxima in it. There is also an incipient cross-girdle. This would also constitute a B $\perp$ B′ tectonite.

Fig. 6 is of an intermediate charnockite (S. 32) from Shervaroys, with faint foliation, perpendicular to which the section was cut. The Quartz grains have a high elongation ratio, 1 : 7. They show undulose extinction. The hypersthene grains are also elongated in the same direction.

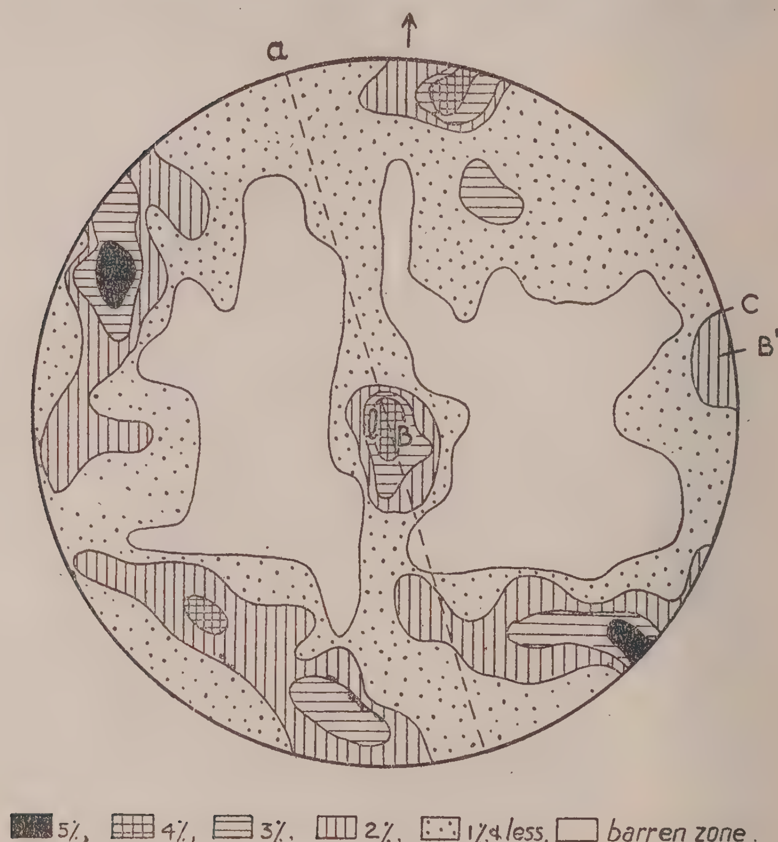



FIG. 6

Quartz diagram of charnockite from Shervaroys, Salem, S. 32.

The diagram shows maxima at the periphery in a peripheral girdle, corresponding to maxima III of Sander (op. cit.). There is a minor maximum in the centre with a faint cross-girdle through it. So this diagram is one of a B $\perp$ B′ tectonite.

Figs. 7 and 8 are of the biotite gneiss (Fig. 7) and charnockite (Fig. 8) from an area where one rock type seems to be included in the other, near Jarugamalai, on the road to Namakkal from Salem. In the biotite-gneiss (S. 54), the biotite is all chloritised. Both plagioclase and Quartz in the slide are granulitised. Quartz shows undulose extinction and the plagioclase lamellae are disturbed. Quartzes, both from the original and the granulitised base, were

measured. The sericite of the plagioclases and the chlorites do not show a preferred orientation. The rock is granitic in texture and the elongated Quartzes show a ratio from 1 : 3 to 1 : 6. The Quartzes in the charnockite (S. 53) show undulose lamellae and are elongated roughly 1 : 5.

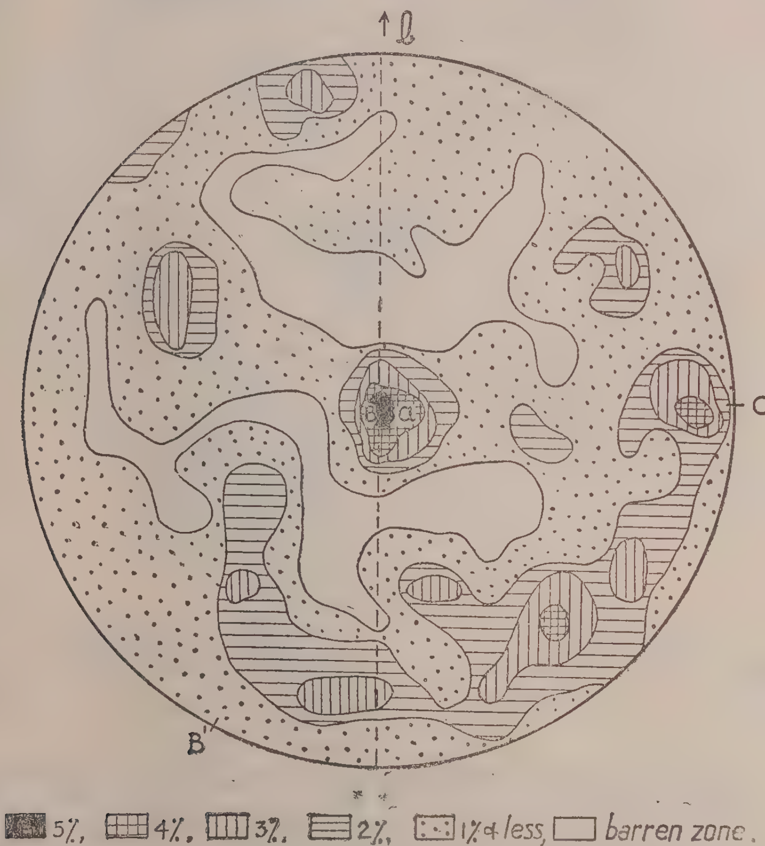



FIG. 7

Quartz diagram of biotite-gneiss on the road to Namakkal. Biotite-gneiss (S. 54) and charnockite are found to be intermixed.

Fig. 7 (biotite-gneiss) shows maximum I, corresponding to a-direction of transport, a peripheral girdle and an incipient cross-girdle. Fig. 8 (charnockite) has maximum I and two maxima IV of Sander (op. cit) symmetrically placed with an ill-developed peripheral girdle. Fig. 7 is of a B ⊥ B′ tectonite.

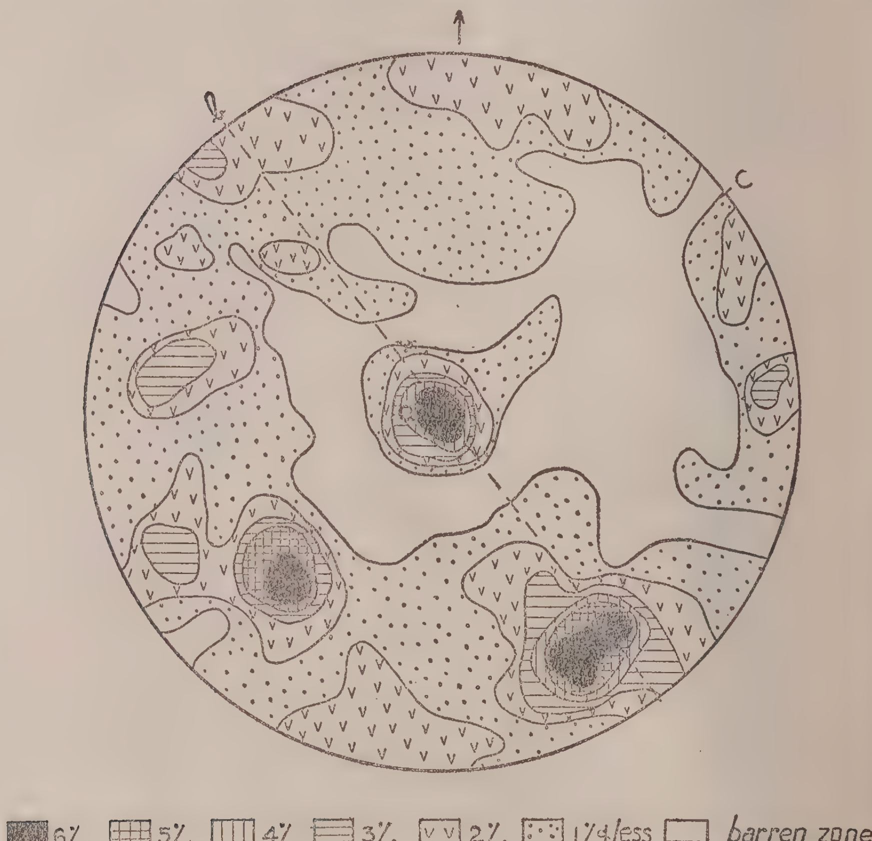
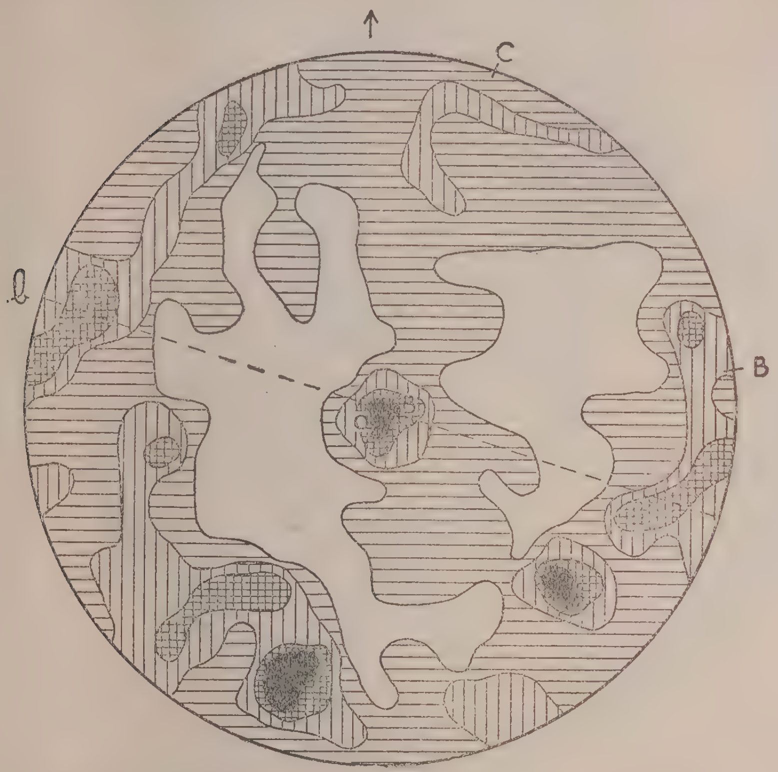



FIG. 8

Quartz diagram of the charnockite part (S. 53) of the above migmatite.

Fig. 9 is that of a basic granulite (S. 58). The rock is dark grey in colour and granulitic in texture. The Quartz grains are equant in shape, sometimes they are elongated with an elongation ratio of 1 : 3. They show undulose extinction with broad lamellae. The section was cut with reference to a neighbouring biotite-gneiss. The mafic minerals are evenly distributed in the slide. The hypersthene grains show elongation to which the few elongated Quartzes are also parallel. The diagram (Fig. 9) shows maxima I and IV. This diagram also would constitute a B $\perp$ B′ tectonite.




4%, 3%, 2%, 1% & less, barren zone.

FIG. 9

Quartz diagram of basic granulite, near Omalur, S. 58.

*Biotite-diagram*

Fig. 10 is that of S. 84, whose Quartz diagram has been described above. (Fig. 4) This shows the characteristic biotite double maxima at the periphery and a well-developed girdle. This helps to fix the direction of foliation of the area, which conforms to the field observation of foliation direction.

*Augite diagram*

An augite diagram of the garnet pyroxene rock has been prepared. The rock shows no foliation and is orientated with reference to a neighbouring biotite-gneiss. The rock shows typical granulitic texture. Some of the pyroxene grains tend to be elongated (elongation ratio 1 : 3), but there is no visible foliation.

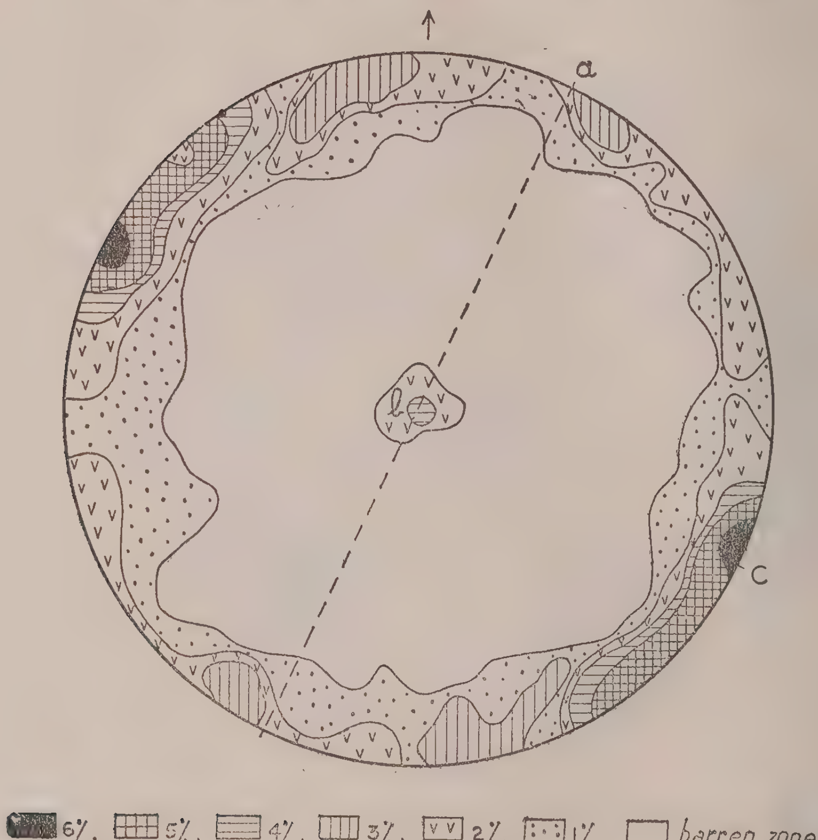
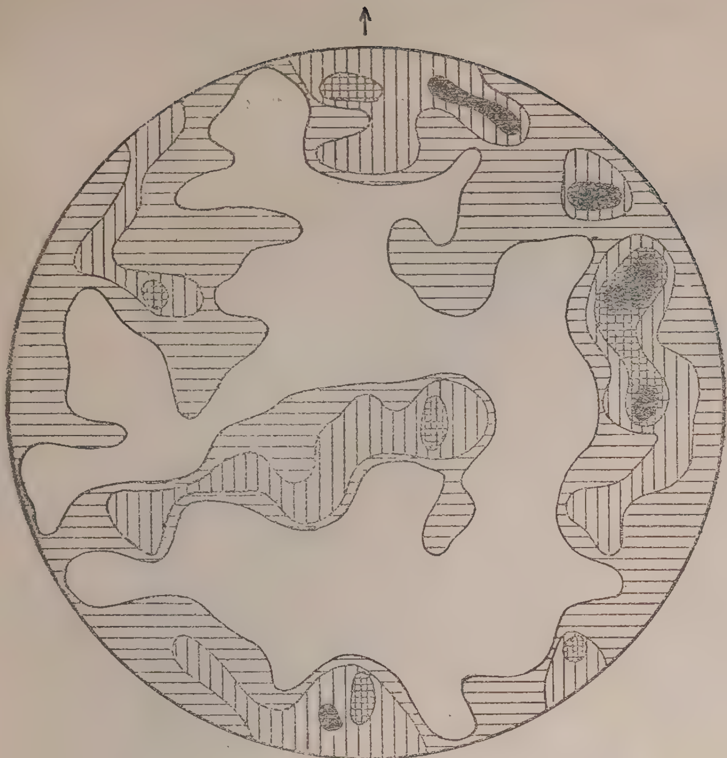



FIG. 10

Biotite diagram of the biotite-gneiss, showing perfect foliation, Salem, S. 84.

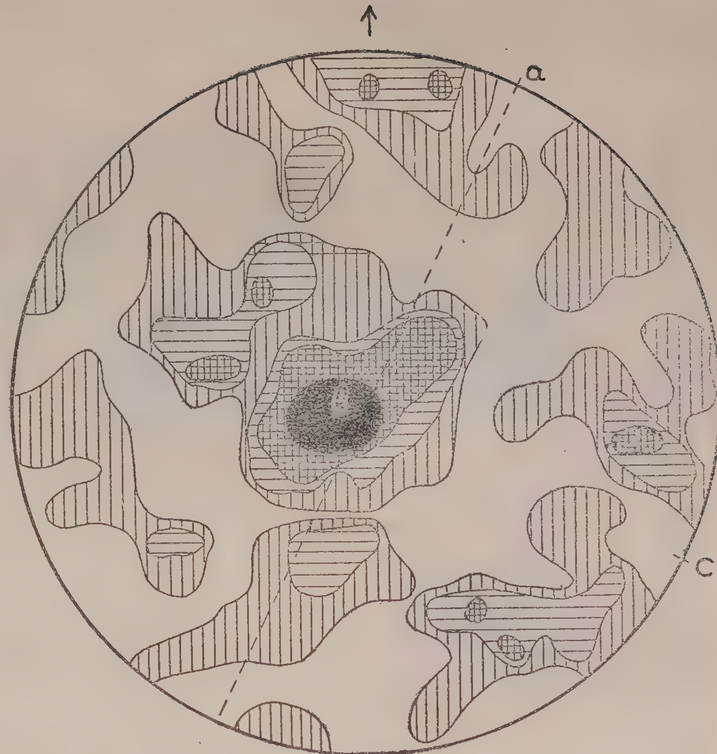
The emergence of the ellipsoidal axes X, Y and Z were plotted separately as Fig. 11 = X; Fig. 12 = Y and Fig. 13 = Z. An inspection of the X diagram shows that there are several maxima distributed along a peripheral girdle. The Y diagram shows a single maxima at the centre and the Z diagram shows irregular distribution of maxima. From this it follows that there has been some orientation in the clinopyroxene, since Y coincides with b crystallographic axis, $\perp$ to (010) and there is a well-pronounced maxima corresponding to (010). It seems reasonable to suppose that we are here dealing with either a depositional fabric where the clinopyroxene grains settled down with their (010) faces flat to the



4%, 3%, 2%, 1%, barren zone.

FIG. 11

Augite diagram of garnet-pyroxene rock, Salem, (X) poles of augite, S. 83.




4%, 3%, 2%, 1%, barren zone.

FIG. 12

Augite diagram of garnet-pyroxene rock, Salem. (Y) poles of augite, S. 83.

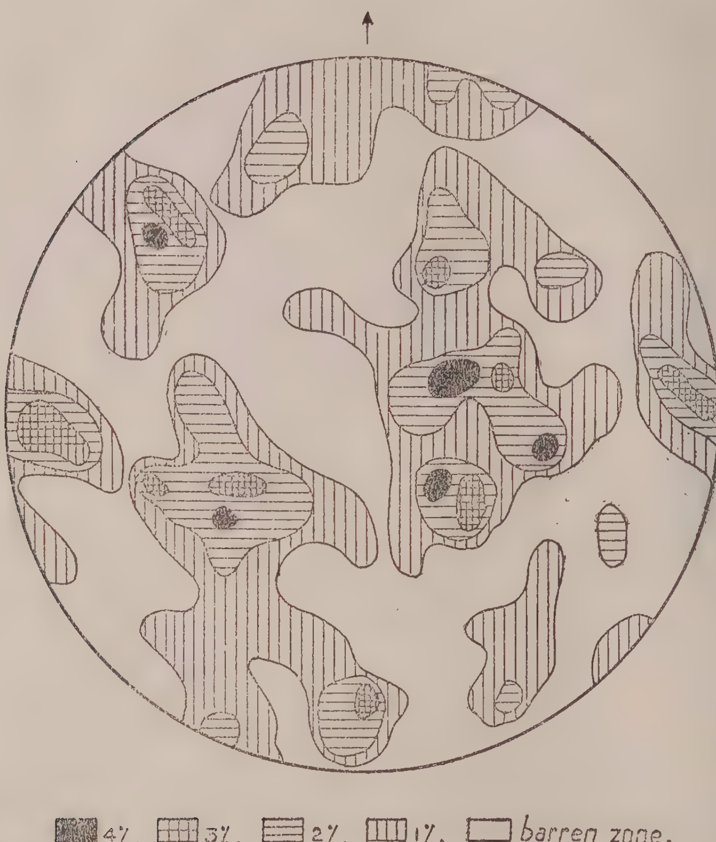



FIG. 13

Augite diagram of garnet-pyroxene rock, Salem. (Z) poles of augite, S. 83.

bottom or that they were compressed in a direction perpendicular to (010) such that the grains aligned themselves parallel to (010). The peripheral distribution of the maximum in the X-axis pattern indicates a compression and rotation along the dome faces. These two forces on the done and clinopinacoid may be regarded as compressional and tensional forces. The Y maximum in the centre corresponds to maximum I of Quartz found in the Quartz diagram of the neighbouring biotite-gneiss. This indicates that the two rocks, the biotite-gneiss and garnet-pyroxene rock have suffered the same degree of metamorphism in time and space.

*Enstatite diagram*

The rock is a pyroxenite from the dunite area, granulitic with no visible foliation. It was oriented in the field with reference to a neighbouring biotite-gneiss. There is neither elongation nor foliation visible even under the microscope. A few of the grains get elongated in the ratio of about 1 : 4, but this elongation has no particular trend. There are prominent cleavages parallel to (100) and undulose lamellae parallel to (001).


Fig. 14

Enstatite diagram of pyroxenite, Ultrabasic mass, Salem. (X) poles of enstatite, S. 85.

The X, Y and Z poles were plotted. The X pole diagram (Fig. 14) shows one maxima and several minor maxima irregularly


FIG. 15

Enstatite diagram of pyroxenite, Ultrabasic mass, Salem. (Y) poles of enstatite, S. 85.

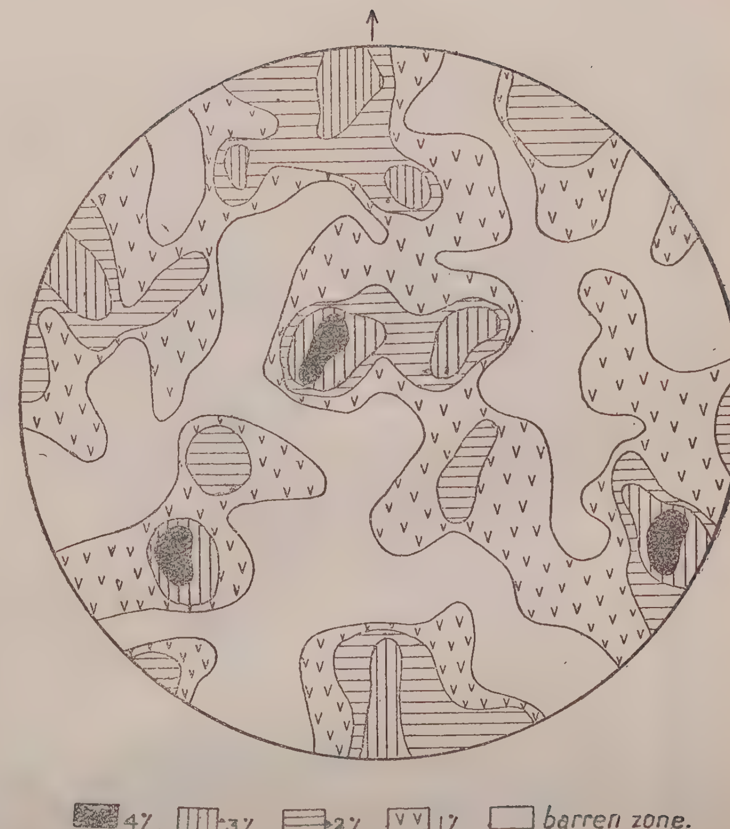



FIG. 16

Enstatite diagram of pyroxenite, Ultrabasic mass, Salem. (Z) poles of enstatite, S. 85.

distributed. This maximum is towards the periphery. The Y poles (Fig. 15) show four maxima, one of them central and the other three distributed near it and several other minor maxima irregularly distributed. The Z poles (Fig. 16) show three maxima almost at 90° from each other and several other minor maxima irregularly distributed. There does not seem to be any indication of orientation in this rock. The best that could be said of orientation is that the majority of the grains were arriving with their (010) faces parallel to the base of deposition.

*Olivine diagram*

An olivine diagram was prepared from the dunite of this area. The rock has a typical granulitic texture and the olivine grains

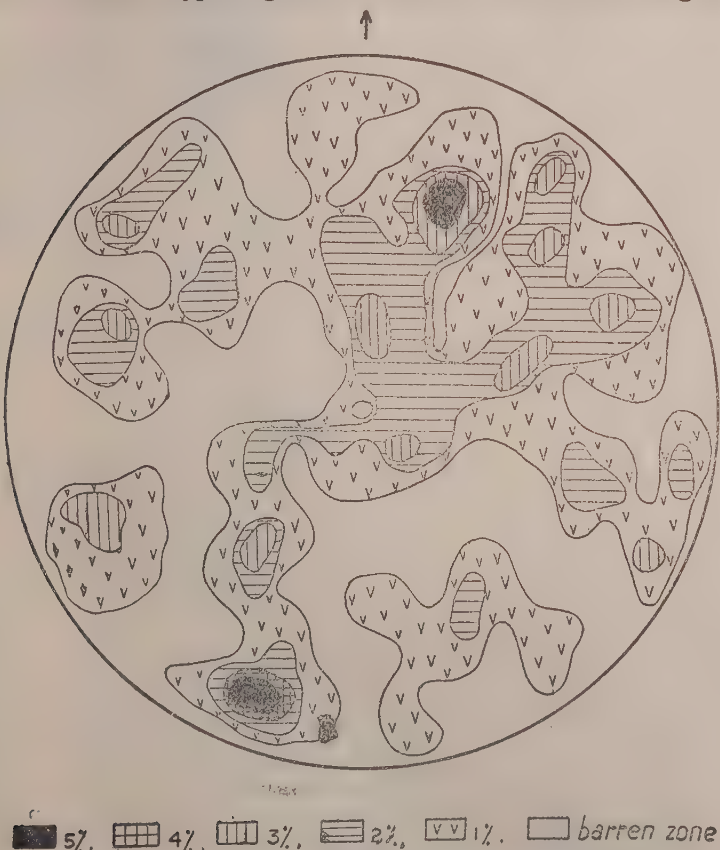
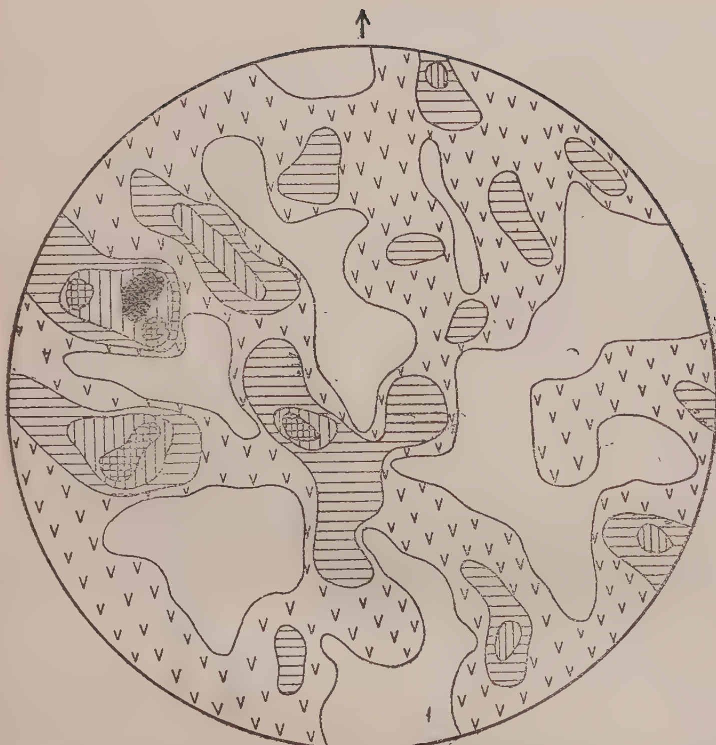



FIG. 17
Olivine diagram of dunite, Ultrabasic mass, Salem.
(X) poles of olivine, S. 86.



5%, 4%, 3%, 2%, 1%, barren zone.

FIG. 18

Olivine diagram of dunite, Ultrabasic mass Salem. (Y) poles of olivine, S. 86.

5%, 4%, 3%, 2%, 1%, barren zone.

FIG. 19

Olivine diagram of dunite, Ultrabasic mass, Salem. (Z) poles of olivine, S. 86.

show the characteristic mesh structure. They show a fine set of cleavages parallel to (010) and undulose translation lamellae parallel to (100). The elongation ratio at times is 1 : 3.

Figs. 17, 18 and 19 are respectively the X, Y and Z pole diagrams of olivine. In all the three diagrams, there are one or two maxima and several minor maxima distributed all over. There is certainly not any preferred orientation in any one of the diagrams. This fact is better evident from the point diagrams of the same poles. We can therefore conclude that there had been no forces operating to orientate these grains since the period of intrusion of the dunite magma.

*Conclusion*

From the above Quartz, biotite, augite, enstatite and olivine diagrams, we can conclude that the Quartz diagrams are all characterized by the maxima I of Sander (op. cit.) which indicate the a-direction of transport. In this respect, including even the leptynite, there is a resemblance to the granulite diagrams prepared by Naidu (1955) and also to those described from German and Finnish rocks (Sander, 1930; Schmidt, 1926: Andreatta, 1933; Cloos, 1935; Sahama, 1936; Sander, 1950). However, the maximum III found in such granulites are not encountered here. But, some cross-girdles observed in the granulites are present in some of these. The diagrams therefore have an affinity to the granulites. Some of them show, B $\perp$ B′ tectonites, as for example, S. 13, from Kusamalai, indicating that there had been two periods of metamorphism. In some diagrams, there are minor maxima, taking up the positions maxima III and IV of Sander (op. cit.). According to him, in his recent AVA technique (Achsenverteilungsanalyse), he pictures a rock which is thoroughly unoriented, to become increasingly oriented in response to translation and rotation during deformational movements. He says the maxima I, II, III and IV develop in response to the movements by gliding along parallel to rhombohedral, prismatic and basal planes. In the rocks of Salem, whose Quartz diagrams are given, maxima I, III and IV develop. This according to Sander's AVA, should be considered as original rocks without preferred orientation which have been subsequently oriented by deformational movements.

The augite diagrams show a Y maximum, corresponding to maxima I of Quartz diagrams of the other rocks, and hence the garnet-pyroxene rock belongs to the same metamorphic period.

On the other hand, the enstatite and olivine diagrams show no preferred orientation and hence these magnesian rich rocks

stand apart in their age as an younger series without any metamorphic imprit.

### Acknowledgment

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# Minerals from the Chamundi Granitic Suite and Associated Rocks, Mysore

BY

S. K. Babu

*Department of Geology and Geophysics, University of Madras, Madras-25*

ABSTRACT

The paper presents the minerology of the granitic rocks of Chamundi and its gneissic environs. Minerals such as amphiboles, biotite, garnet, pyroxene, felspars have been mechanically separated and chemically analysed. The optical characters and chemistry of the above minerals are briefly discussed.

This paper deals with the optical and chemical properties of (1) Felspars: —Plagioclase, Potash felspar and Myrmekites (2) Amphiboles (3) Garnet (4) Biotite and (5) Pyroxene.

## *Felspars*

*Plagioclase Felspars:*—The rock types of Chamundi hills collected from different parts of the hills were studied for the determination of the anorthite content and twin laws of the plagioclases. The determinations were carried out in accordance with the method of Reinhard (1931) and by the method of Rittmann (1929).

600 grains from 50 sections were measured on the Fedorov's stage and the results were interpreted according to plates 2, 3 and 4 of Reinhard (1931). In the case of doubtful interpretation, the construction of the twin axes was resorted to and the results interpreted by means of Reinhard's plate 5. In all cases the pole of the twin plane was located by Nikitin's construction and its position in the triangle of error was determined by Berek's method of locating the twin plane and therefrom the twin axis. The

anorthite content and twin laws in different rock types are recorded in Table I.

TABLE I

| Rock type | An. Content | Albite Law | Combined albite and Pericline Law | Manebach Law | Baveno Law | Manebachala = Acline = Pericline | Albite-ala | Albite-carlsbad | Carlsbad |
|---|---|---|---|---|---|---|---|---|---|
| 1. Pink Porphyritic granite | 13-25% | 20 | 5 | — | — | 2 | 22 | — | — |
| 2. Grey porphyritic granite | 12-27% | 26 | 3 | 1 | — | — | 17 | 1 | 1 |
| 3. Mixture of 1 & 2 | 20-29% | 9 | 1 | — | — | — | 8 | — | — |
| 4. Coarse grained grey granite | 15-30% | 27 | 2 | 4 | 2 | — | 28 | 1 | 2 |
| 5. Fine grained grey granite | 10-29% | 10 | 1 | — | — | — | 7 | — | — |
| 6. Coarse grained pink granite | 9-32% | 33 | 3 | 4 | — | 1 | 27 | — | 1 |
| 7. Fine grained pink granite | 15-32% | 24 | — | 1 | — | — | 24 | 1 | 1 |
| 8. Granodiorite | 15-38% | 14 | 1 | 1 | 1 | — | 15 | — | — |
| 9. Medium grained pinkish grey granite | 10-32% | 31 | 4 | 2 | — | 2 | 30 | — | — |
| 10. Granitic Gneisses | 15-40% | 40 | 6 | 7 | — | 11 | 36 | — | — |
| 11. Amphibolites | 27-35% | 7 | 3 | — | — | — | 5 | — | — |
| 12. Hornblende Schists | 20-35% | 5 | — | 2 | — | — | 4 | 1 | — |
| 13. Pegmatites | 13-30% | 9 | — | — | — | — | 11 | 1 | — |
| 14. Aplites | 22-28% | 6 | — | — | — | — | 6 | — | 1 |
| 15. Crushed Granites | 15-29% | 5 | 1 | 1 | — | — | 9 | — | 1 |
| Total | | 266 | 30 | 23 | 3 | 16 | 249 | 5 | 7 |

The twin laws that have been noticed among the different rocks of Chamundi and the surrounding gneisses are albite, albite-ala, pericline, Manebach and Manebach-ala acline; Carlsbad and albite-carlsbad laws are practically absent, and are found only in a few grains. The paucity of the occurrence of carlsbad and albite-carlsbad in the plagioclases of granitic rocks have also been observed by Babu (1955), Raghavan (1954) and Suryanarayana (1955). Out of the 600 grains determined 266 are albite and 249 are albite-ala. These two laws preponderate in the granites of Chamundi.

The pericline twin occurs as fine lamellae across the albite twin. Albite-ala law is as much characteristic of granites and gneisses as albite and periclin laws. A similar conclusion has been arrived at by Naidu (1954) and Raghavan (1954) in their studies on "Granites and Granites" and Jalarpet granites respectively.

The anorthite content of the granites of Chamundi range in general from 12% — 34% (albite to endesine). A cumulative diagram of the anorthite content is given in Fig. 1. (010) is more common as twinning plane than (001). The poles show a remarkable dispersal from the curves though not of the magnitude noted by Homma (1932) and Paliuc (1932) in effusive rocks. Barber (1936) has suggested that this dispersal may be overcome by locating the optical symmetry plane, instead of the morphological composition face in normal twins. The poles form a band as noted by Monolescu (1934).

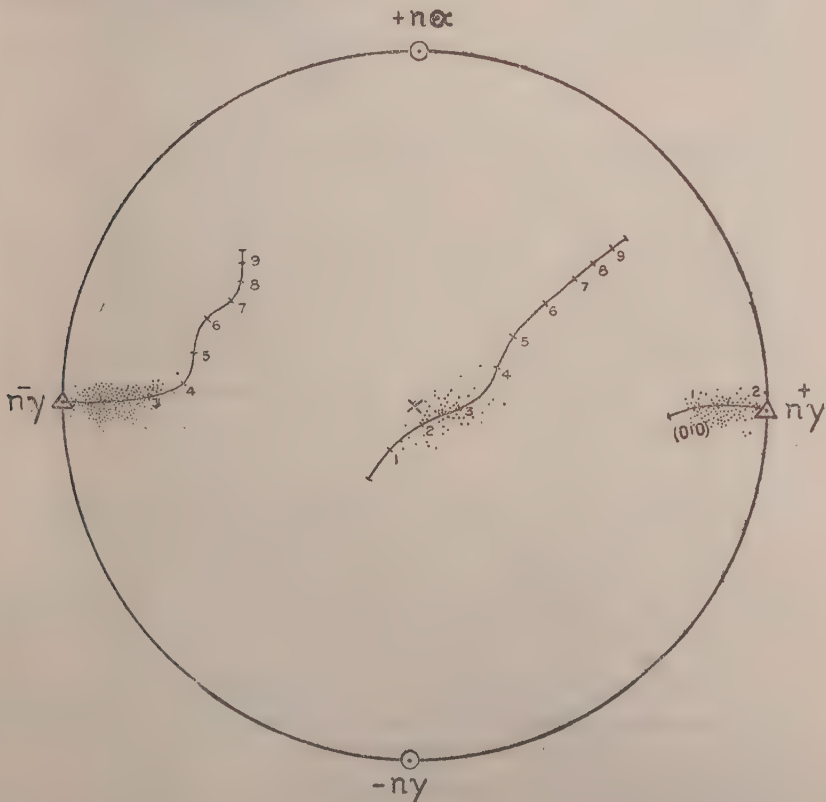


FIG. 1
A cumulative diagram of the anorthite content.

Campbell Smith (1928) has remarked that the results for the poles of the twin axes are of a higher degree of accuracy than those for the plane of association. The poles of the twin axes of parallel and complex twins located by Nikitin's and Berek's constructions are plotted in Fig. 2.

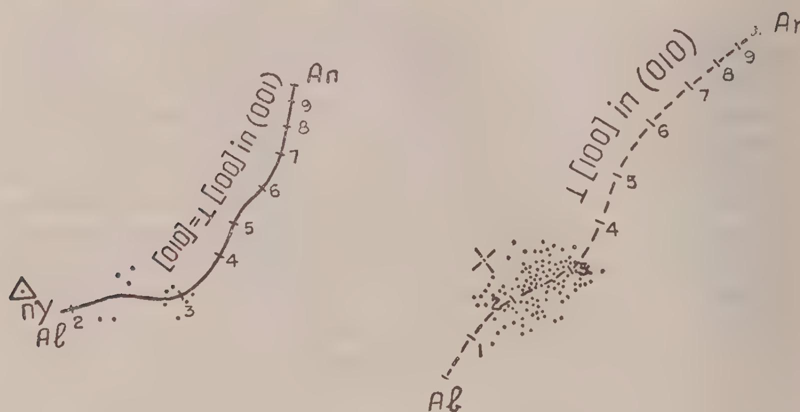


FIG. 2

Poles of the twin axes of complex and parallel twins located by Berek's and Nikitin's constructions.

Tertsch (1942) has made a distinction between high and low temperature optics of the felspars and has constructed stereogram on (010) with the wandering of X, Y, Z ellipsoidal axes for the various anorthite contents. The curves are distinguished as high and low temperature curves. The transferred poles of the ellipsoidal axes of the felspars here determined when plotted on this Tertsch stereogram (1942) give points on the low temperature curves (Fig. 3).

The Chamundi felspars are generally in agreement with the low temperature optics of Köhler (1942) and Tertsch (1942).

Among the plutonic rocks, Gorai (1951) records albite-ala twin as nil, for the anorthite content 25% — 49%. It is well-known that the distinction between the albite and albite-ala law at anorthite content 30% — 35% is very difficult, and this conflict is very frequent. Hence a distinction between albite and albite-ala seems very essential. The conflict was solved by applying Nikitin's construction and Coulson's check (1932).

Coulson (1932) has indicated the frequency of albite-ala B twins in plagioclases of 33% anorthite, content. The author how-

ever has recorded this law in plagioclase felspars of Chamundi, between 15% — 28% anorthite content. Similar observations have been made by Raghavan (1954), Ramanathan (1954) and Suryanarayana (1955).

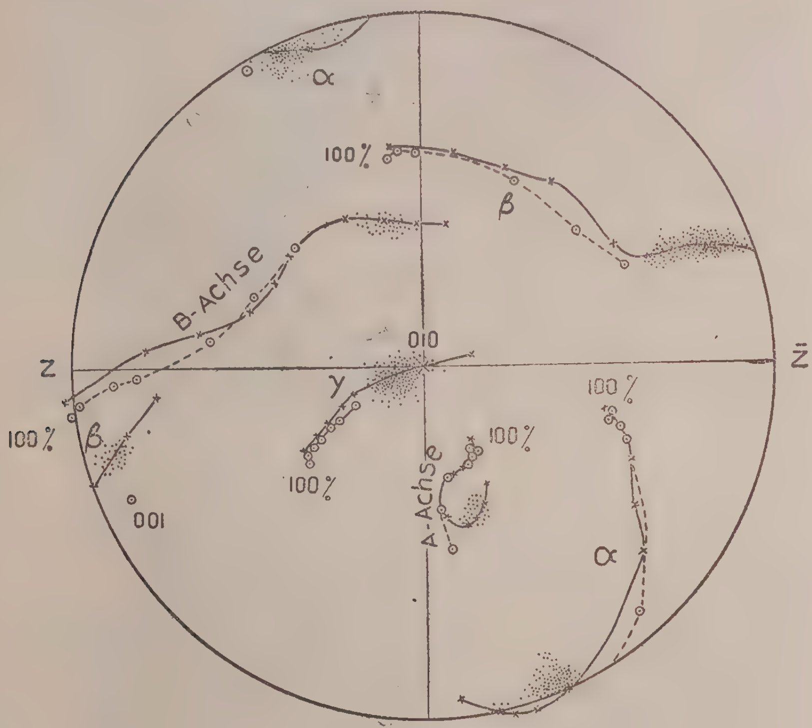


Fig. 3

Stereogram after Tertsch (1942, p. 200, fig. 1).

*Optic axial angle*

The optic axial angles determined are plotted in Fig. 4. The points do not show a pronounced dispersion.

*Zoning in plagioclase*

Zoning is not pronounced in the granites of Chamundi. Occasionally we find feeble oscillatory zoning developed in them. Very occasionally the cores of the plagioclase crystals may be composed of potash felspar and in one case a distinct zone was observed. Similar zoning has been observed by Chudoba (1930). In some

of the granites we also find reverse zoning. The zoning is very distinct and the anorthite percentage ranges from 18% — 22%. Sometimes as many as 20 zones are noticed. Long finger-like embayments of the ground mass penetrate into the interior of the phenocrysts and in some cases the euhedral shape is destroyed. They are aligned with sericite. If the sericite is rich in potash then it would appear probable from its general abundance that some potassium has been introduced hydrothermally. All the zoned crystals observed in these granites consist invariably of two halves twinned on manebach law and in only one of the individual do we notice zoning. The other half which appears to be untwinned reveals the presence of twin lamallae on tilting on the Fedorov's

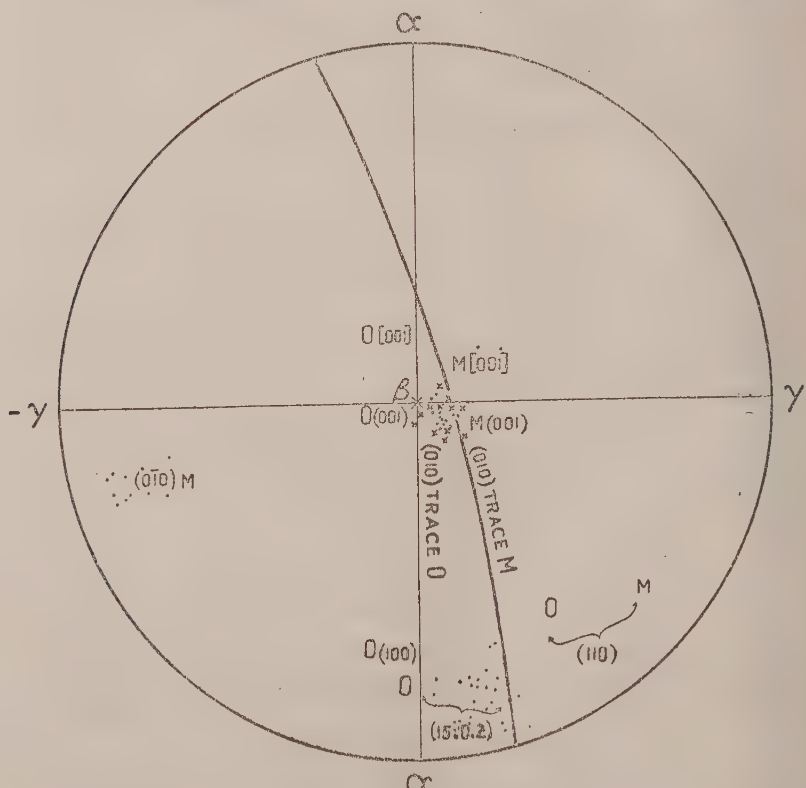


Fig. 4

Optical orientation of plagioclases.
X and —— low temperature optics.
O and .... high temperature optics.

stage and has an anorthite percentage of 20. The zoning could not be determined by the method of Reinhard. Hence the zoning was worked out by Extinction angle method. The anorthite percentage oscillates from 14 — 18.

The origin of oscillatory zoning in plagioclase has been much discussed and notable contributions have been made by Bowen (1928, pp. 274-5), Fenner (1926, pp. 700-3), Harloff (1927), Homma (1932), Phemister (1934) and Hills (1936). The theories of Harloff, Phemister and Hills are based mainly on considerations of the phase diagram of the An-Ab system and involve rhythmic changes in composition of a melt round a growing plagioclase crystal. Bowen, Fenner and Homma have suggested that other processes may have been operative, amongst them being movement of crystals within a magma and mixing of magmas themselves.

When applied to the oscillatory zoning in the plagioclase of the Chamundi, Homma's theory probably explains the origin of zoning in the plagioclase of the Chamundi granites.

*Potash Felpars*

In the study and discussion of the origin of granites great emphasis is now being placed on the nature of potash felspars. Of the two types of felspars, orthoclase and microcline, which are the chief constituents of granites, orthoclase is rather rare. Within the world-wide Pre-Cambrian basement complex, orthoclase has been reported as an essential felspar only in granites corresponding to the metamorphism of granulite facies (Eskola, 1952) and microcline has often been explained to be an alteration product of the former. Microclines are common in most granites and these microclines are often perthitic.

Orthoclase, microcline and perthites are now definitely regarded on the basis of experimental proof as different modifications of the potash felspars containing a small amount of sodic felspar in isomorphous solution. The different forms assumed by potash felspar are functions of temperature. Orthoclase being stable at higher temperature, perthite at low temperature and the intermediate form microcline occupying a position in between orthoclase and perthite in regard to its temperature of formation. The occurrence of potash felspars in any one of these three different forms in granites gives an indication as to the temperature of formation of these granites and to a certain extent their genetic history.

*Microclines*:—Though a few grains of microcline are untwinned, most of the grains are twinned showing the typical cross hatching. The grating differs in coarseness in the same grain at different portions. Majority of the microclines are perthitic.

Many of the microclines show broad lamallae like plagioclase, but the stereograms of these grains do not coincide with those of oligoclases but fit into Nikitin's stereogram for microcline. The poles of twin lamellae coincide either with (010) or in the neighbourhood of (15·0·2) 84° removed from (001). These are albite and pericline lamellae developed in microcline.

A few grains of microcline show simple twinning like orthoclase but their (001) pole coincides with that of microcline on Nikitin's stereogram and the twinning is after the albite law. Most of the microclines are fresh and untwinned. They do not display cross hatching. There are well developed two sets of cleavages namely (001) and (15·0·2). The optic axial angle varies from $-78°$ to $-84°$.

The microcline has in it inclusions of plagioclase, biotite, sphene, epidote arranged in definite directions. Some of them are arranged parallel to albite lamellae and others to pericline lamellae, while many of the micas are arranged parallel to (110) faces. Some of the inclusions are parallel to an irrational plane.

*Micro-Perthite*:—The perthitic lamellae of microclines are often invisible under the microscope, but when rotated on one of the horizontal axes of the universal stage their presence is revealed. The perthite spindles are parallel to 'C' axis or nearly so. Sections on (010) show the fine longitudinal perthitic lamellae and well-developed (001) cleavages. The spindles make an angle of 78° with the cleavage (001). The poles of the lengths of the perthitic lamellae fall on or nearer to M (100) and hence parallel to (100). In some cases the poles of the perthitic lamellae which are fine and closely spaced fall on (15·0·2). Sections parallel to (001) do not show perthitic lamellae as they are cut perpendicular to such lamellae. On the other hand they show grating structure formed by the intersection at right angles of albite and pericline lamellae.

Alling (1938) has evolved certain techniques for a detailed study of perthites. Spencer of Burns & Company, India has also made valuable contributions to the study of perthites in general.

Recently much work has been done on the origin and study of perthites by Emmons (1953) and Higazy (1949). Alling classifies the perthites depending upon their shape and size and occurrence as stringlets, strings, beads, rods, bands, films, patch type and plume type. Their zonal distribution indicates that rods and blebs do not reach the margin of the host grain while the strings occupy most of the grain leaving the margin free. The stringlets are mostly confined to a zone close to the margin but the extreme margin is usually free. Stringlets are slender, needle-like with a common length of 0·01 mm. and width of 0·00075 mm. Strings are double tapering needles commonly 0·06 mm. in length and 0·001 mm. in width. Rods are larger with a sausage shape or round, commonly 0·06 mm. to 0·12 mm. in length and 0·02 mm. in width. They are very irregular in occurrence. In many cases beads are nothing but cross sections of rods. The films are thin plates irregular in shape and size. In length they vary from 0·1 to 0·5 mm. and in width 0·01 to 0·15 mm. Bands are wider and broader varying in length from 0·1 mm. to 0·6 mm. and 0·02 mm. to 0·17 mm. in width. Patch perthites are ladder shaped, and plume perthites are also broad and look like feathers.

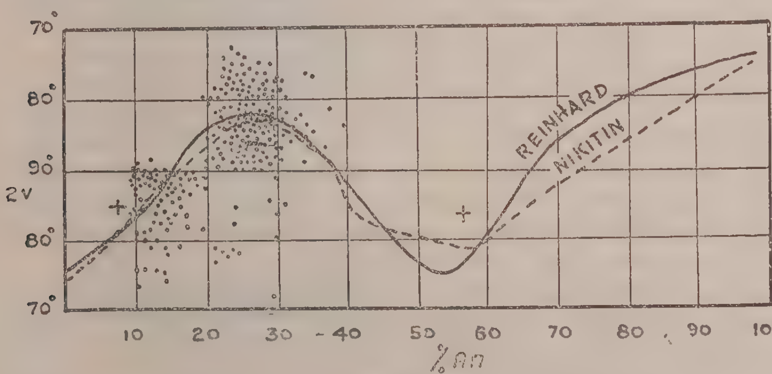


Fig. 5

Cumulative diagram of the poles of the perthitic lamallae and inclusions and (001) cleavage traces of the potash felspars.
.... represent poles of perthitic lamallae.
xx represent poles of (001) cleavages.

*Criteria for the recognition of the various plutonic perthites*

(1) The uniformity of the shape and size, exhibited by the stringlets, strings, rods and beads, etc.

(2) The definite orientation usually parallel to (100) or nearly so, (010), parallel to (001) and (110).

(3) They have no connection with the margin of the host.
(4) They avoid the zones near the inclusions of quartz.
(5) They are larger and abundant near the neighbouring grains of felspar.

*Criteria for the recognition of various kinds of replacement perthite*

(1) The perthitic guests are larger (films, beads, plume and patch).
(2) They are more irregular in shape and they do not maintain the same degree of uniformity in orientation.
(3) They often cut the margin of the host.
(4) They occur near margins sending tongues into the host.
(5) They are present near the inclusion of quartz.

According to Alling's classification of perthites, the perthites of Chamundi granites fall under rods, spindles, blebs and string types. Vein and patch type of perthites are found only in phenocrysts of microclines of porpyritic granite. The rod types of perthites are more common. Rods are spindle shaped tapering at both ends. In some grains we also see string type of perthites, and the en-echelon arrangement of strings is very prominent. In some cases the sodic material which initially occurs as strings runs into pools of oligoclase. The rods have a wide range in their size. Length of each rod ranges from 0·0276 mm. — 0·740 mm., the most common range being 0·739 — 0·130 mm. The width has a smaller range from 0·0042 — 0·0369 mm. At the middle, the most common range being 0·0090 — 0·183 mm. The range in size of the different blebs in perthites of Chamundi granites are given for comparison along with those given by Alling.

| Perthites in Chamundi Granites | | | Alling's plutonic perthites | | |
|---|---|---|---|---|---|
| Term | Length | Width | Term | Length | Width |
| Stringlet | Occasionally present. | | Stringlet | 0·01<br>0·0075-<br>0·0225 | 0·00075<br>0·00088-<br>0·0012 |
| String | 0·049<br>0·018-<br>0·070 | 0·0092<br>0·0041<br>0·0132 | String | 0·06<br>0·02-<br>0·09 | 0·001<br>0·00075-<br>0·0175 |
| Rod & Bead | 0·126<br>0·072-<br>0·71 | 0·017<br>0·0092-<br>0·0370 | Rod & Bead | 0·08<br>0·02-<br>0·30 | 0·02<br>0·01-<br>0·05 |

From the criteria suggested by Alling the author regards the inclusions as due to ex-solution, where with declining temperature of metamorphism two phase equilibria were set up in the original

microcline and plagioclase. The evidence in support of this conclusion is: (1) The guests are uniform in size; (2) They are small in size; (3) They are not connected with the margin of the host; (4) They occur sparingly around quartz inclusions. There are also evidences of replacement origin in case of the perthites noticed in the phenocrysts of microcline of porphyritic granite. Hence in the granites of Chamundi there are both plutonic and replacement perthites.

### *Chemical composition of microcline perthites*

The phenocrysts of felspars were collected in the field by chistling and scooping. They were then crushed and treated with bromoform. The light fractions was further resolved into microperthite and quartz by treating the light fraction with bromoform diluted with benzene.

Thus two microperthites one from a grey phenocryst of the porphyritic granite, another from a pink phenocryst of porphyritic granite were separated and chemically analysed. The chemical analysis of perthites are given below together with their norms and other analysis for comparison.

*Chemical analysis of microcline perthites*

| Constituents | Pink type | Grey type | Comparison | | Norms | | |
|---|---|---|---|---|---|---|---|
| | | | Greator Rocks. | Haytor (E.) Qy. | | Pink type | Grey type |
| $SiO_2$ | 65·31 | 64·91 | 65·53 | 64·87 | | | |
| $Al_2O_3$ | 19·03 | 19·18 | 18·81 | 19·18 | Qz: | 2·64 | 1·32 |
| $Fe_2O_3$ | 0·43 | 0·24 | 0·12 | 0·16 | Or: | 72·84 | 61·72 |
| CaO | 0·44 | 1·50 | 0·58 | 0·50 | Ab: | 20·96 | 30·92 |
| BaO | 0·09 | 0·06 | 0·12 | 0·14 | An: | 2·50 | 5·00 |
| $Na_2O$ | 2·50 | 3·65 | 2·70 | 2·95 | Wol: | — | 0·35 |
| $K_2O$ | 12·36 | 10·36 | 12·03 | 11·67 | Cor: | 0·61 | — |
| MgO | Tra. | 0·02 | Tr. | 0·17 | Hae: | 0·70 | 0·16 |
| $TiO_2$ | Tra. | — | 0·03 | 0·01 | $H_2O$: | 0·24 | 0·67 |
| $H_2O^+$ | 0·24 | 0·67 | 0·44 | 0·41 | | | |
| $H_2O^-$ | 0·09 | 0·13 | 0·20 | 0·29 | | | |
| Total | 100·49 | 100·52 | 100·56 | 100·35 | Total | 100·49 | 100·14 |
| Sp. Gr. | 2·567 | 2·582 | | | | | |

Analysis of pink and grey types of perthites. Analyst: S. K. Babu.
Analysis of Dartmoor felspar. Analyst: H. F. Harwood.

*Origin of microperthite*:—Kozu, Endo, and Spencer (1937, 1938) have shown by thermal experiments conducted by them that orthoclase with 30% or more of soda dissolved in it is stable at high temperature (750°C). With a fall of temperature to 500° orthoclase inverts to triclinic form, microcline, with the simultaneous separation of the sodic component to form perthitic texture with the development of cross hatching at the same time. This sodic component separates out because of its reduced solubility in potash felspars under decreasing temperatures. Under slow cooling ex-solution of the sodic component to form perthitic lamallae is possible.

The microcline perthites of Chamundi suggest conversion to low temperature of the potash felspars. The optic axial angle of microcline varies from − 83° to − 86°. Rarely in one or two cases an angle of − 73° was noted. The poles of the (001) cleavages of microcline are slightly dispersed towards O (001), thereby indicating that some of the microclines have not attained their triclinicity completely. Recently Howie (1955) has shown by X-ray investigations of the position and separation of the (130) and (130) reflections: the separation of these two reflections may be considered as a means of the "triclinicity." The presence of a few grains of microcline with 2V = − 73°, the presence of a few grains of untwinned microclines in these granites and the dispersal of poles of (001) cleavages towards O (001) indicate that the microcline and microcline perthites of the above granites have crystallised between temperatures 500° − 750°C the ex-solution temperature fixed by Spencer.

The presence of rod, string and spindle types of perthites and their growth away from the margin of the grains' boundaries indicate that the soda component necessary for the formation of these perthites must have been derived from a local source, by the ex-solution of soda component present in solid solution in potash felspar.

The vein and patch type of perthites found in some of the phenocrysts of porphyritice granites are of later origin as they cut across the string and rod perthites. Under the influence of pressure the sodic material ex-solved from potash felspars must have attained mobility. This mobile sodic component must have linked up the small rods, forming pools and veins of albite in the microcline to form vein perthites.

*Myrmekites*:—Myrmekite textures found in Chamundi granites are in striking conformity with the myrmekites observed by Becke (1908), Sederholm (1916) and Suryanarayana (1955). Myrmekites found in Chamundi granites consist of quartz and plagioclase felspars, quartz occuring in vermicular fashions inside the plagioclase. These myrmekites occur as protuberences with convex surfaces projecting into microcline perthites. They are to be found at the junction of two minerals between quartz and microcline and between plagioclase and microcline. The vermicular quartz is invariably found concentrated at the convex side of myrmekite. Myrmekites occur between quartz and microcline and appear to grow out from quartz margin into microcline.

Becke and Sederholm point out that myrmekites are formed by the replacement of potassium of orthoclase and microcline by sodium and calcium; the sodium would be exchanged atom for atom with the potassium yielding an equivalent of albite, but with calcium, anorthite would be formed in place of potassium felspar. As anorthite would require a low percent of silica for its formation this would release the equivalent of four molecules of silica as indicated by the following equation

$$2KAlSi_3O_8 + CaO \longrightarrow CaAl_2Si_2O_8 + 4SiO_2 + K_2O$$

hence the quantity of quartz will be greater, the more basic the plagioclase is, and the potash felspar goes to form biotite.

The proportion of quartz to felspar increases with the basicity of plagioclase according to Becke and Sederholm. In Chamundi granites it is found that, the concentration of worm-like quartz at the convex surface of the wart-like myrmekite and their absence at the interior of the plagioclase, indicates the more basic nature of the plagioclase at the convex borders than at its interior. The anorthite content of the plagioclase in the myrmekite ranges from 15% – 20%.

Many petrographers are of the opinion that myrmekites are formed by the replacement of potash felspar by solutions rich in soda and lime with release of quartz. This theory is equally applicable to myramekites of Chamundi also. The plagioclase fraction of the perthites and myrmekites must have been derived by unmixing from potash felspars. The plagioclase fraction thus exsolved attains mobility and behaves like a fluid under the influencs of prevalent differential pressure. These have filled up the fractures in certain phenocrysts of microclines forming vein

perthites while at other portions they have replaced potash felspars to form myrmekites.

### *Mafic minerals*

The mafic minerals occuring in the granitic rocks of Chamundi as well as their gneissic environs have not been worked so far. Some of these minerals have now been chemically analysed and their optical characters determined.

*Separation of minerals:*—The crushed powders passed through 80 mesh sieve were separated in bromoform. Iron ores were removed from the heavy residue by a horse-shoe magnet.

Biotite was separated from a basic schlieren occuring in granite. It was found to be associated with epidote. The heavy residue of biotite from bromoform was treated with clerici's solution diluted with water, drop by dorp till the epidote sank. This process was repeated several times till a fairly pure crop of biotite was obtained. The biotite analysed was almost pure.

Bronzite was separated from a pure bronzite schist, which however did not require beyond bromoform separation. The material analysed was pure.

Garnets, one from garnetiferous-biotite-gneiss and another from garnetiferous amphibolite were separated. The heavy residue from bromoform was treated with clerici's solution diluted with water. Garnet sank and the amphibole and mica floated.

Brown amphibole from one of the crystals occuring in hornblende schist was taken, crushed and separated in bromoform. The material obtained was almost pure, as the rock was entirely composed of brown amphibole.

Two other varieties of amphiboles from amphibolites, consisting of amphiboles, little plagioclase and iron ore were separated first in bromoform and then in clerici's solution diluted in water. The little mica present along with hornblende floated and amphibole sank. Next the hornblende crop obtained was then tapped off on a finely ruled paper pad when the amphibole grains rolled off and the mica flakes adhering to the paper pad were tapped and removed. After repeated sieving and tapping and final treatment with clerici's solution, pure crops of hornblende were obtained.

*Methods of optical examinations:*—Refractive indices were determined in refractive index liquids from the powder used in chemical analysis. The indices $\alpha$, $\gamma$ were determined on cleavage flakes parallel to (010). The index $\beta$ was determined on grains perpendicular to an optic axis. $\alpha$ and $\gamma$ for the amphiboles and pyroxenes were determined from the birefringences $(n\beta - n\alpha)$ and $(n\gamma - n\beta)$ by the method of Hess (1936).

Optic axial angle was determined by the Fedorov method as described by Reinhard and the angle was measured on the Kantrol or k axis. In case of hornblendes showing strong absorbtion the method outlined by Naidu (1955) was applied. Specific gravity was determined by the suspension method using clerici's solution and 5 c.c. pycnometer, care being taken to drive out all air bubbles by gentle heating on a water bath.

*Orthopyroxene:*—The pyroxene analysed is from a pure bronzite schist which occurs as a pocket here and there in the garnetiferous amphibolite of the Varuna schist belt. It occurs as big plates of ½ c.m. in length. The plates are lustrous and exhibit schillerisation. There are well developed two sets of cleavages namely (001) and (100). Lamellar structure is present. Most of the grains show straight extinction. But a few grains show inclined extinction. This extinction observed is only on sections inclined to the three crystallographic axes. When tilted on the Fedorov's stage the inclined extinction disappears and straight extinction results. This inclined extinction has been observed by many workers in the orthopyroxenes of charnockites (Henry 1940, Rao 1954). The causes and the possibility of getting this extinction have been discussed by Naidu (1955).

The optical characters determined are:—

$$\left.\begin{array}{l} n\,\alpha = 1\cdot619 \\ n\,\beta = 1\cdot632 \\ n\,\gamma = 1\cdot649 \end{array}\right\} \pm 0\cdot001$$

$$(n\,\gamma - n\alpha) = (0\cdot030) \quad \text{From refractive indices.}$$

The optic axial angle as determined by direct measurement on the universal stage, where both the optic axes emerge gave the value $+ 88°$. Applying Tröger's correction for segment 1·649 that was used, the true angle was $+ 86°$.

The chemical analysis of the pyroxene is presented together with Warren's formula in Table II.

TABLE II

| Constituents | Wt. % | Mol. Props. | Metal atoms | (O, OH, F) | Basis 6 (O, OH, F) | Ti replacing Si. | Ti replacing Fe, Mg. |
|---|---|---|---|---|---|---|---|
| $SiO_2$ | 48·41 | 0·807 | 0·807 | 1·614 | 1·744 | | |
| $TiO_2$ | 0·17 | 0·002 | 0·002 | 0·004 | 0·004 | 2·00 | 1·996 |
| | | | | | 0·252 | | |
| $Al_2O_3$ | 7·24 | 0·071 | 0·142 | 0·213 | 0·055 | | |
| $Fe_2O_3$ | 0·65 | 0·004 | 0·008 | 0·012 | 0·017 | | |
| FeO | 12·35 | 0·172 | 0·172 | 0·172 | 0·372 | 1·794 | 1·794 |
| MnO | 0·06 | 0·001 | 0·001 | 0·001 | 0·002 | | |
| MgO | 24·95 | 0·624 | 0·624 | 0·624 | 1·348 | | |
| CaO | 2·70 | 0·048 | 0·048 | 0·048 | 0·104 | | |
| $Na_2O$ | 0·70 | 0·011 | 0·022 | 0·011 | 0·048 | 0·169 | 0·169 |
| $K_2O$ | 0·44 | 0·004 | 0·008 | 0·004 | 0·017 | | |
| $H_2O^+$ | 1·44 | 0·078 | 0·156 | 0·078 | 0·337 | 0·337 | |
| $H_2O^-$ | 0·43 | — | — | — | — | — | |
| Total | 99·54 | | — | 1·990 | 2·781 | — | — |

$$\underbrace{1\cdot990 \quad 2\cdot781}_{4\cdot771}$$

$$F = \frac{6}{2\cdot781} = 2\cdot158$$

Sp. Gravity :—3·095

Analyst: S. K. Babu.

*Valency Check* :—

| | | |
|---|---|---|
| Si | = | 6·976 |
| Ti | = | 0·016 |
| Al | = | 0·921 |
| Fe | = | 0·051 |
| Fe | = | 0·744 |
| Mn | = | 0·004 |
| Mg | = | 2·696 |
| Ca | = | 0·208 |
| Na | = | 0·048 |
| K | = | 0·017 |
| | | 11·681 |

| | | |
|---|---|---|
| OH | = | 0·337 |
| H | = | 11·326 |
| | | 11·663 |

The formula of the mineral on the basis of 6 (O, OH, F) atom is (Mg, Fe''', Fe'', Ca, Na, K) $(Si, Ti, Al)_2$. Titanium and aluminium are here regarded as replacing silica. The bases fall short of the ideal 2 atoms by 0·005, a deficiency that is noted in many analyses of pyroxenes.

Hess (1949) gives the general formula of Warren and Berman for any pyroxene as,

$(W)_{1-p}\ (X, Y)_{1-p}\ Z_2\ O_6$ with the value $p = 1$ and $W = 0$ in orthopyroxenes the formula then simplifing to $(X, Y)_2\ Z_2\ O_6$. The atoms in the above analysis may be distributed according to this scheme in the following way:

*Chemical analysis of orthopyroxene calculated after the method of Hess.*

| Constituents | Wt. % | Mol. No. | Atomic ratios. | Na, Fe | Na, Al | W, Y, Z | Cations 6(0) |
|---|---|---|---|---|---|---|---|
| $SiO_2$ | 48·41 | 807 | 807 | | | | |
| $Al_2O_3$ | 7·24 | 71 | 142 | | 142 | 949Z | 2·05 |
| $Fe_2O_3$ | 0·65 | 4 | 8 | | | | |
| FeO | 12·35 | 172 | 172 | | | | |
| MgO | 24·95 | 624 | 624 | | | | |
| CaO | 2·70 | 48 | 48 | | | | |
| $Na_2O$ | 0·70 | 22 | 44 | 44 | | W, X, Y-915 | 1·97 |
| $K_2O$ | 0·44 | 8 | 16 | | | | |
| MnO | 0·06 | 1 | 1 | | | | |
| $TiO_2$ | 0·17 | 2 | 2 | | | | |

The proportion of cations to 6 O, Z: WXY = 2·05: 1·97 is within the limit of error prescribed by him.

*Nomenclature:*—Poldervaart (1947) has proposed the following scheme for the nomenclature of the pyroxenes.

$En_{100} - En_{90}$ = Enstatite

$En_{90} - En_{70}$ = Bronzite

$En_{70}$ — $En_{50}$ = Hypersthene

$En_{50}$ — $En_{30}$ = Ferro-hypersthene

$En_{30}$ — $En_{10}$ = Eulite

$En_{10}$ — $En_0$ = Orthoferrosalite

Here the ratio of En is 73: 27 and therefore the mineral is well within the limit of Bronzite. When plotted in the linear diagram of Poldervaart (Fig. 6), it falls in the bronzite field.

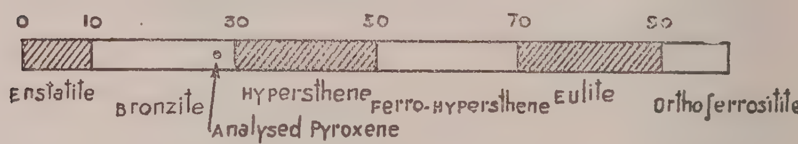


FIG. 6

*Brown amphibole*: —Brown amphibole from a hornblende schist was chemically analysed. The amphibole shows indication that it has developed at the expense of clino and orthopyroxene. In some specimens the plagioclase may be rare and quartz may increase in amount. Quartz is always rounded and occurs both in amphibole and in the rest of the slide. The amphibole sometimes shows a sieved structure with rounded quartz inclusions.

The optical characters are:—

| | |
|---|---|
| $n\,\alpha = 1{\cdot}654$ | X = brownish-yellow |
| $n\,\beta = 1{\cdot}666$ | Y = Yellowish-green |
| $n\,\gamma = 1{\cdot}676$ | Z = Dark green |
| | Absorbtion: $X<Y>Z$ |

$(\gamma - \alpha) = 0{\cdot}021$

$(\beta - \alpha) = 0{\cdot}013$

$(\gamma - \beta) = 0{\cdot}009$

$Z \wedge C = 16°$, $-2V = 77°$ $p<v$

Sp. Gr. $= 3{\cdot}127$.

The chemical composition of the amphibole is given in Table III.

TABLE III

| Constituents | Wt. % | Mol. Props. | Metal atoms | (O, OH, F) | Basis 24 (O, OH, F). | Ti replacing Si. | Ti replacing Fe, Mg. |
|---|---|---|---|---|---|---|---|
| $Si_2O$ | 40·32 | 0·672 | 0·672 | 1·344 | 6·105 | | |
| $TiO_2$ | 1·12 | 0·014 | 0·014 | 0·028 | 0·127 | 8·00 | 8·000 |
| | | | | | 1·768 | | |
| $Al_2O_3$ | 11·70 | 0·115 | 0·230 | 0·345 | 0·321 | | |
| $Fe_2O_3$ | 3·47 | 0·022 | 0·044 | 0·066 | 0·400 | | |
| FeO | 11·91 | 0·165 | 0·165 | 0·165 | 1·499 | 5·381 | 5·381 |
| MnO | 0·10 | 0·001 | 0·001 | 0·001 | 0·009 | | |
| MgO | 13·90 | 0·347 | 0·347 | 0·347 | 3·152 | | |
| CaO | 12·20 | 0·218 | 0·218 | 0·218 | 1·981 | | |
| $Na_2O$ | 2·95 | 0·047 | 0·094 | 0·047 | 0·854 | 2·890 | 2·890 |
| $K_2O$ | 0·34 | 0·003 | 0·006 | 0·003 | 0·055 | | |
| $H_2O^+$ | 1·40 | 0·078 | 0·156 | 0·078 | 1·417 | | |
| $H_2O^-$ | 0·37 | — | — | — | — | | |
| $P_2O_5$ | Tra. | | | | | | |
| Total | 99·78 | | 1·947 | 2·642 | | | |

$$\underbrace{1\cdot947 \quad 2\cdot642}_{4\cdot589}$$

$$F = \frac{24}{2\cdot642} = 9\cdot084 \qquad V = \frac{2400}{2\cdot642 \times 3\cdot127} = 290$$

Sp. Gravity:—3·127

Analyst: S. K. Babu.

*Valency Check:*

| | | | |
|---|---|---|---|
| Si | = 24·420 | OH | = 1·417 |
| Ti | = 0·508 | O | = 45·164 |
| Al | = 6·267 | | 46·581 |
| Fe | = 1·194 | | |
| Fe | = 2·998 | | |
| Mg | = 6·304 | | |
| Mn | = 0·018 | | |
| Ca | = 3·962 | | |
| Na | = 0·854 | | |
| K | = 0·055 | | |
| | 46·580 | | |

In the allotment of atoms, Ti is reckoned with Si, after Kunitz (1930, p. 217). Berman (after Warren) (1937, p. 354) gives the general formula for the hornblende as

$$(W, X, Y)_{7-8} \ (Z_4O_{11})_2 \ (O, OH, F)_2$$

where W = Ca, Na, K; X = Mg, Fe, Mn, Al in part; Y = Al, Fe. Ti; Z = Si, Al in part. According to Kunitz the formula of the mineral is

$$(WXY)_{8\cdot271} \ (Z_4O_{11})_2 \ (O, OH, F)_{1\cdot418} \text{ or}$$

$(Ca, Na, K, Fe''', Fe'', Mg, Mn; \ Al)_{8\cdot271} \ (Si, Al, Ti)_{8\cdot00} \ O_{22}$ $(O, OH, F)_{1\cdot418}$ and according to Berman the formula is;

$$(WXY)_{8\cdot269} \ Z_{7\cdot873} \ O_{22} (O, OH, F)_{1\cdot418} \text{ or}$$

$$(Ca, Na, K, Fe''', Fe'', Mg, Mn, Ti, Al)_{8\cdot271} \ (Si, Al)_{8\cdot000} \ (O, OH, F)_{1\cdot418}$$

According to the mode of classification adopted by Kunitz there is no deficiency in the silica group, but according to Berman's method there is a little deficiency of 0·027 in the silica group and a corresponding excess in the bases.

Berman (1937, p. 351) classifies the hornblende series as follows:

| W | Y | Z = Si: Al |
|---|---|---|
| 5 | 0 | 7:1 = Hornblende-Edenite |
| 4 | 1 | 6:2 = Hastingsite |
| 3 | 2 | 8:0 = Glaucophane |
| 4·660 | 0·847 | 6:2 = Analysed mineral |

These figures indicate that the analysed hornblende has the bulk character of hastingsite with alkalic affinities. The refractive indices agree with those of green hornblendes.

*Blue-green amphiboles:*—Two amphiboles from amphibolites B/20, B/70 were analysed. The optical characters of the amphiboles are;

B/20

$n\,\alpha = 1{\cdot}659$    X = Light yellow
$n\,\beta = 1{\cdot}671$    Y = Yellowish-green
$n\,\gamma = 1{\cdot}679$    Z = Bluish-green

$(\gamma - \alpha) = 0{\cdot}024$
$(\beta - \alpha) = 0{\cdot}018$

$Z \wedge C = 23°$
$-2V = 65°$
Sp. Gr. $= 3{\cdot}228$

B/70

$n\,\alpha = 1{\cdot}631$    X = Colurless to Light yellow
$n\,\beta = 1{\cdot}652$    Y = Yellowish-green
$n\,\gamma = 1{\cdot}657$    Z = Bluish-green

$(\gamma - \alpha) = 0{\cdot}020$
$(\beta - \alpha) = 0{\cdot}012$

$Z \wedge C = 15°$
$-2V = 57°$
Sp. Gr. $= 3{\cdot}203$

According to Kunitz the formula of the mineral (Si replacing Ti).

B/20 $(Ca, Na, K, Fe''', Fe'', Mg, Mn, Al)_{8\cdot071}$ $(Si, Ti, Al)_{8}$
$(O, OH, F)_{1\cdot388}$

According to Berman (Ti replacing Fe, Mg);

$(Fe''', Fe'', Mg, Mn, Ca, K, Al, Ti)_{8\cdot071}$ $(Si, Al)_{8\cdot000}$
$(O, OH, F)_{1\cdot388}$

The mineral has characters of common hornblendes with alkalic offinities.

B/70 According to Kunitz the formula of the mineral is;

$(Ca, Na, K, Fe''', Fe'', Mn, Mg, Ti, Al)_{8\cdot087}$ $(Si, Ti, Al)_{8}$ $O_{22}$
$(O, OH, F)_{1\cdot004}$

According to Berman the formula is;

$(Ca, Na, K, Fe''', Fe'', Mg, Mn, Ti, Al)_{8\cdot087}$ $(Si, Al)_{8\cdot000}$
$(O, OH, F)_{1\cdot004}$

The mineral has characters of hornblende-edenite with more alkalic affinities,

S. 12.

The chemical composition of the two amphiboles are presented in Table IV.

TABLE IV

B/20

| Constituents | Wt. % | Mol. Props. | Metal atoms | (O, OH, F) | Basis 24 (O, OH, F). | Ti replacing Si. | Ti replacing Fe, Mg. |
|---|---|---|---|---|---|---|---|
| $SiO_2$ | 44·01 | 0·733 | 0·733 | 1·466 | 6·519 | | |
| $TiO_2$ | 0·73 | 0·009 | 0·009 | 0·018 | 0·080 | 8·000 | 8·000 |
| $Al_2O_3$ | 11·26 | 0·111 | 0·222 | 0·333 | 1·401 | | |
| | | | | | 0·537 | | |
| $Fe_2O_3$ | 1·76 | 0·011 | 0·022 | 0·033 | 0·196 | | |
| FeO | 11·64 | 0·161 | 0·161 | 0·161 | 1·432 | | |
| MnO | 0·20 | 0·003 | 0·003 | 0·003 | 0·027 | 5·136 | 5·136 |
| MgO | 13·08 | 0·327 | 0·327 | 0·327 | 2·908 | | |
| CaO | 12·76 | 0·228 | 0·228 | 0·228 | 2·028 | | |
| $Na_2O$ | 2·85 | 0·046 | 0·092 | 0·046 | 0·818 | | |
| $K_2O$ | 0·51 | 0·005 | 0·010 | 0·005 | 0·089 | 2·935 | 2·935 |
| $H_2O^+$ | 1·40 | 0·078 | 0·156 | 0·078 | 1·388 | | |
| $H_2O^-$ | 0·20 | — | — | — | — | | |
| Total | 100·4 | | 1·963 | 2·698 | | | |

$$\underbrace{1{\cdot}963 \quad 2{\cdot}698}_{4{\cdot}661}$$

Analyst: =S. K. Babu.

$$F = \frac{24}{2{\cdot}698} = 8{\cdot}894 \qquad V = \frac{2400}{2{\cdot}698 \times 3{\cdot}203} = 277$$

*Valency Check:*

| | |
|---|---|
| Si | = 26·076 |
| Ti | = 0·320 |
| Al | = 5·922 |
| Fe | = 0·588 |
| Fe | = 2·864 |
| Mn | = 0·054 |
| Mg | = 5·816 |
| Ca | = 4·056 |
| Na | = 0·818 |
| K | = 0·089 |
| | 46·603 |

OH = 1·388
O = 45·224

46·612

(TABLE IV (contd.)

B/70

| Constituents | Wt. % | Mol. Props. | Metal atoms | (O, OH, F) | Basis 24 (O, H, F) | Ti replacing Si. | Ti replacing Fe, Mg. |
|---|---|---|---|---|---|---|---|
| $SiO_2$ | 45·03 | 0·750 | 0·750 | 1·500 | 6·750 | 8·000 | 8·000 |
| $TiO_2$ | 0·94 | 0·011 | 0·011 | 0·022 | 0·098 | | |
| $Al_2O_3$ | 11·51 | 0·113 | 0·226 | 0·339 | 1·152 | | |
| | | | | | 0·876 | | |
| $Fe_2O_3$ | 0·54 | 0·003 | 0·006 | 0·009 | 0·054 | 5·076 | 5·076 |
| FeO | 13·53 | 0·188 | 0·188 | 0·188 | 1·687 | | |
| MnO | 0·11 | 0·001 | 0·001 | 0·001 | 0·009 | | |
| MgO | 10·90 | 0·273 | 0·273 | 0·273 | 2·450 | | |
| CaO | 12·66 | 0·226 | 0·226 | 0·226 | 2·028 | 3·122 | 3·122 |
| $Na_2O$ | 3·10 | 0·050 | 0·100 | 0·050 | 0·897 | | |
| $K_2O$ | 1·01 | 0·011 | 0·022 | 0·010 | 0·197 | | |
| $H_2O^+$ | 1·02 | 0·056 | 0·112 | 0·056 | 1·005 | | |
| $H_2O^-$ | 0·01 | — | — | — | — | | |
| Total | 100·36 | | 1·915 | 2·675 | | | |

Analyst :—S. K. Babu.

$$\underbrace{1{\cdot}915 \quad 2{\cdot}675}_{4{\cdot}590}$$

$$F = \frac{24}{2{\cdot}675} = 8{\cdot}973 \qquad V = \frac{2400}{2{\cdot}675 \times 3{\cdot}228} = 277$$

The niggli values for these amphiboles were calculated and compared with the values given by Niggli (1945, Table 9, p. 69-70). The values do not correspond with the values given for basaltic hornblendes, but lie within the range of values given for common hornblendes.

Niggli values for the amphiboles

| | Si | al | fm | c | alk |
|---|---|---|---|---|---|
| Niggli values for Common hornblende | 75–101 | 6–17 | 52–66 | 21–29 | 2–7 |
| Brown amphibole | 71·50 | 12·24 | 59·26 | 23·19 | 5·32 |
| Common hornblende B/20 | 81·17 | 12·29 | 56·80 | 25·24 | 5·64 |
| Blue-green amphibole B/70 | 86·42 | 13·02 | 53·92 | 26·04 | 7·02 |

The Niggli basis for the three amphiboles are calculated and presented below.

Niggli Basis for the amphiboles

| | Brown amphibole | Common hornblende | Blue-green amphibole |
|---|---|---|---|
| Kp .. | 1·00 | 3·66 | 1·62 |
| Ne .. | 15·74 | 16·63 | 14·91 |
| Cal .. | 10·88 | 8·66 | 9·73 |
| Cs .. | 12·81 | 14·48 | 13·61 |
| Fs .. | 3·68 | 0·50 | 5·34 |
| Fa .. | 13·90 | 15·72 | 13·29 |
| Fo .. | 28·86 | 22·71 | 26·50 |
| Ru .. | 0·77 | 0·61 | 0·49 |
| Q .. | 12·31 | 17·03 | 14·51 |
| Q .. | 12·31 | 17·03 | 14·51 |
| L .. | 27·67 | 28·95 | 26·26 |
| M .. | 60·02 | 54·02 | 59·23 |

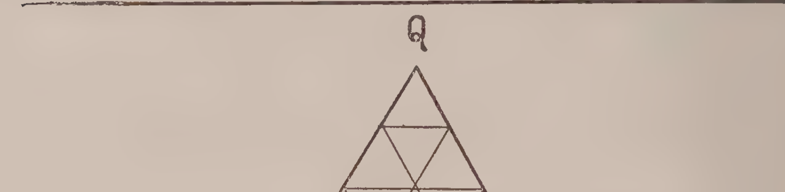


FIG. 7

1. Grunerite and altered hornblendes. 2. Aenigmatite. 3. Alkalie hornblendes. 4. Common hornblendes. 5. Barkavikite, hastingsite, basaltic hornblendes. 6. Melilite. I, II and III — Analysed amphiboles.

The Q.L.M. values of these amphiboles are plotted in the Niggli (1945) diagram. All the points lie in the field of amphiboles of eruptive field. The brown amphibole falls in the Hastingsite field, while the other two fall in the common hornblende field, and on the boundary between common hornblende and hastingsite field. (Fig. 7).

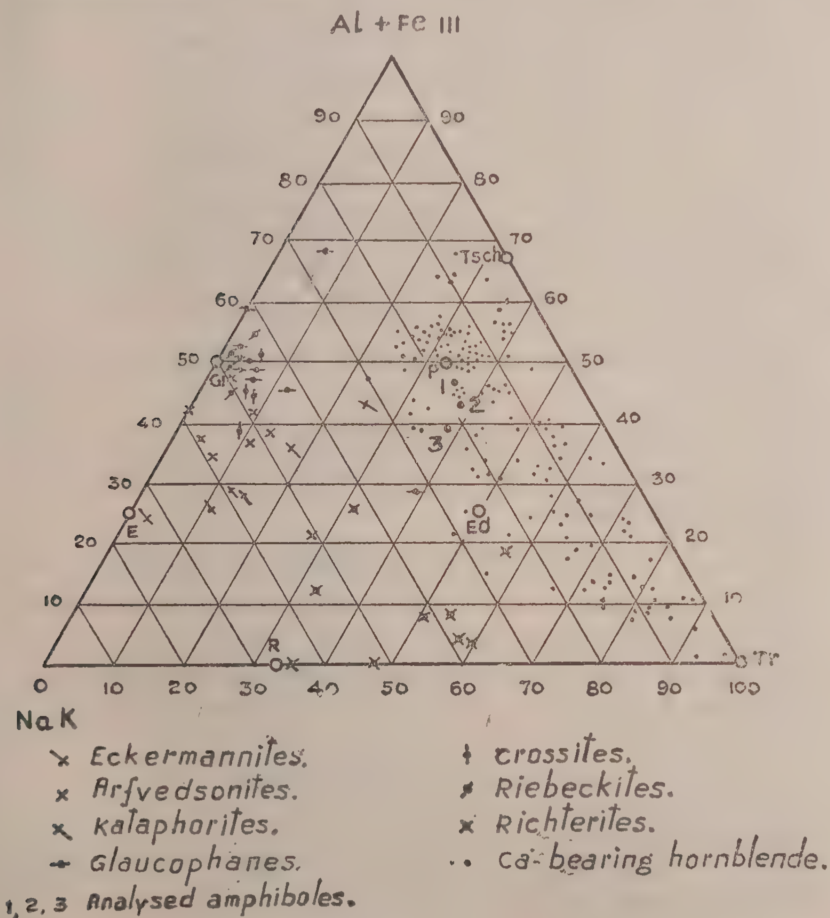


FIG. 8

Sundius (1946) has studied the miscibility relationship of calciferous amphiboles. Plotting the values (Na, K), Ca, Al, Fe, in his diagram the points of the blue green amphiboles as well as brown amphibole all lie in the field of calciferous amphiboles.

The points of the blue-green amphiboles take the position between pargasite and edenite in the less miscibility field, thereby indicating that they are composed of the molecules pargasite and edenite. (Fig. 8).

*Biotite*:—Biotite in the granites of Chamundi are of several types namely (1) Reddish-brown; (2) Greenish-brown; (3) Yellowish-brown. Reddish-brown variety occurs in garnetiferous-biotite gneiss. Biotite develops at the expense of iron ore.

The biotite analysed is from one of the caughtup basic biotite schlierens in the granite and is of the yellowish-brown variety.

The chemical composition of the biotite is presented in Table V.

*Formulae*:—Hallimond (1925) has proposed the general formula for micas as 6 $SiO_2$ $K_2O$ mRO $nR_2O_3$ $2H_2O$ and that Ti should be considered as replacing Si. The Biotite has the formula:

$$6(Si, Ti)O_2\ 2Al_2O_3\ 5(Fe, Mg, Mn)O\ (Ca, Na, K)_2O\ 2H_2O$$

Berman (1935) gives the formula on structural basis for biotites as:

$$W\ (XY)_{2-3}\ Z_4\ O_{10}\ (O, OH, F)_2$$

when the ratio of Si: al in Z is 5:3 to 7:1. Cast into this form the formula of biotite is:

$$(Ca, Na, K)_{1\cdot02}\ (Mg, Fe, Ti, Al)_{2\cdot92}\ (Si, Al)_{4\cdot000}\ (O, OH, F)_{1\cdot70}$$

There is a deficiency of 0·30 in the (O, OH, F) group which is a common deficiency noted by Winchell (1935).

The Niggli values for the analysed biotite were calculated and the values correspond to the values given by Niggli for biotites.

Niggli values for analysed biotite

| | Si | al | fm | c | alk | k | mg |
|---|---|---|---|---|---|---|---|
| Niggli values for biotites | 66–84 | 22–19 | 67–72 | 0·05 | 12–15 | 0·7–1 | 0·1–0·9 |
| Analysed biotite | 69·56 | 17·36 | 69·10 | 0·92 | 12·62 | 0·83 | 0·53 |

TABLE V

| Constituents | Wt. % | Mol. Props. | Metal atoms | (O, OH, F) | Basis 600 (Si, Ti) $O_2$ | Basis 12 (O, OH, F) | |
|---|---|---|---|---|---|---|---|
| $SiO_2$ | 36·08 | 601 | 601 | 1·202 | — | 2·72 | 4·00 (Z) |
| | | | | | | 1·28 | |
| $Al_2O_3$ | 15·31 | 150 | 300 | 0·450 | | 0·08 | |
| $Fe_2O_3$ | 6·40 | 40 | 80 | 0·120 | 190 $R_2O_3$ | 0·36 | |
| FeO | 14·16 | 197 | 197 | 0·197 | | 0·89 | 2·79 |
| MnO | 0·34 | 4 | 4 | 0·004 | | 0·02 | + 0·13 Ti. |
| MgO | 10·70 | 316 | 316 | 0·316 | 519 RO | 1·44 | |
| CaO | 0·46 | 8 | 8 | 0·008 | | 0·04 | |
| $Na_2O$ | 1·12 | 18 | 36 | 0·018 | 111 $R_2O$ | 0·16 | 1·02 |
| $K_2O$ | 8·62 | 91 | 182 | 0·091 | | 0·82 | |
| $H_2O^+$ | 3·32 | 183 | 366 | 0·183 | 179 $H_2O$ | 1·66 | |
| $H_2O^-$ | 1·21 | — | — | — | | | 1·70 |
| F | 0·16 | 5 | 10 | 0·005 | | 0·04 | |
| $TiO_2$ | 2·33 | 29 | 29 | 0·058 | | 0·13 | |
| Total | 100·21 | | | 2·652 | | | |
| Less O for F | 0·08 | | | | | | |
| | 100·13 | | | | | | |

$$F = \frac{12}{2 \cdot 652} = 4 \cdot 526$$

Analyst: S. K. Babu.

Sp. Gravity:—3·110

$n\beta = n\gamma - 1 \cdot 613$

$n\alpha - 1 \cdot 568$ (Determined by Peacock and Fergusson Method 1943)

Uniaxial, X = Brownish-yellow, Y = Z Dark brown.

The Q.L.M. values were calculated for the biotite and the Q.L.M. values when plotted in the Niggli diagram (1945) falls in the biotite field of eruptive field. (Fig. 9).

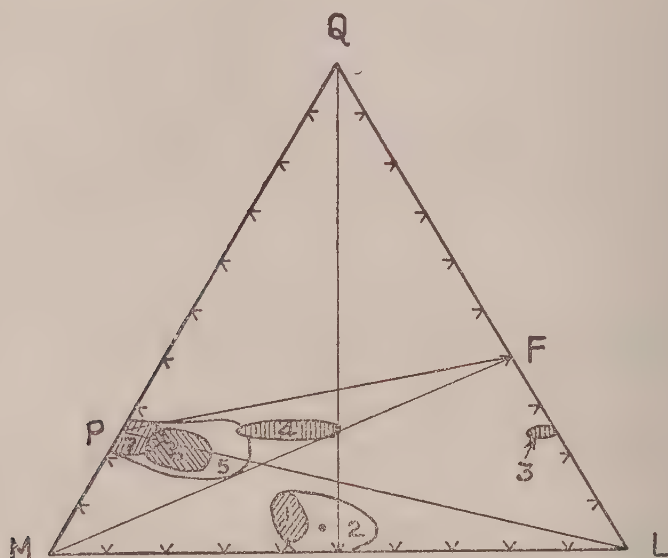


FIG. 9

1. Wichtige Biotite and Lepidomelane. 2. Biotite. 3. Jadeit. 4. Omphacitartigé augite. 5. Pyroxene. 6. Wichtige gewöhnliche augite. 7. Wichtige orthaugite, pigeonite, diopsidartig augite. * Analysed Biotite.

*Garnet*:—Garnets occur in pegmatites, aplites, garnetiferous amphibolites and garnetiferous-biotite gneiss. They occur as small rounded grains to massive garnets. Two garnets, one from amphibolite and another from garnetiferous-biotite gneiss have been chemically analysed. Reddish brown mica is formed at the expense of garnet. Garnet exhibits sieve structure with rounded quartz and sometimes felspar too.

The chemical composition of the garnets are presented in Table VI.

Allowing 0·02 to replace Si and 0·27 to replace the base the formula of the mineral is:

B/140

$$(Fe''', Fe'', Mn, Mg, Ca, Al)_{2\cdot 88}\ Al_2\ (Si, Ti, Al)_3\ O_{12}$$

TABLE VI

B/140

| Constituents | Wt. % | Mol. Props. | Metal atoms | Basis (O, OH, F) | Basis 12 (O, OH, F) | |
|---|---|---|---|---|---|---|
| $SiO_2$ | 37·62 | 0·627 | 627 | 1254 | 2·86 | |
| $TiO_2$ | 0·23 | 0·003 | 3 | 6 | 0·01 | 3·00 |
| | | | | | 0·13 | |
| $Al_2O_3$ | 28·03 | 0·274 | 548 | 822 | 2·37 | 2·00 |
| $Fe_2O_3$ | 0·29 | 0·002 | 4 | 6 | 0·02 | |
| FeO | 23·21 | 0·322 | 322 | 322 | 1·47 | |
| MnO | 1·63 | 0·023 | 23 | 23 | 0·11 | 2·88 |
| MgO | 7·29 | 0·182 | 182 | 182 | 0·83 | |
| CaO | 1·04 | 0·018 | 18 | 18 | 0·08 | |
| $H_2O^+$ | 0·22 | — | — | — | — | |
| $H_2O^-$ | 0·19 | — | — | — | — | |
| Total | 99·75 | | | 2633 | | |

Analyst: S. K. Babu

$$F = \frac{12}{2 \cdot 633} = 4 \cdot 557$$

Sp. Gravity:—3·772

n$\beta$ — 1·785 for sodium light (determined by immersion method)

B/108

$(Fe''', Fe'', Mn, Mg, Ca, Al)_{2 \cdot 95}\ Al_2\ (Si, Ti, Al)_3\ O_{12}$

The Ti is regarded as replacing Si after Kunitz (1935). Calculated in terms of standard molecules, they have the composition:

B/108

| | |
|---|---|
| Spessartite .. | 1·94 |
| Andradite .. | 3·48 |
| Grossularite .. | 3·81 |
| Almandine .. | 64·58 |
| Pyrope .. | 26·15 |
| | 100·00 |

TABLE VI (Contd.)

| Constituents | Wt. % | Mol. Props. | Metal atoms | (O, OH, F). | Recalc. to 100 | Mol. Props. | Metal atoms | (O, OH, F) | Basis 12 (O, OH, F) | |
|---|---|---|---|---|---|---|---|---|---|---|
| $SiO_2$ | 37·56 | 0·626 | 0·626 | 1·252 | 37·77 | 0·629 | 0·629 | 1·258 | 2·94 | 3·00 |
| $TiO_2$ | 0·15 | 0·002 | 0·002 | 0·004 | 0·15 | 0·002 | 0·002 | 0·004 | 0·01 | |
| | | | | | | | | | 0·05 | |
| $Al_2O_3$ | 22·85 | 0·224 | 0·448 | 0·672 | 22·98 | 0·225 | 0·450 | 0·675 | 2·06 | 2·00 |
| $Fe_2O_3$ | 1·11 | 0·007 | 0·014 | 0·021 | 1·12 | 0·007 | 0·014 | 0·021 | 0·07 | 2·98 |
| FeO | 28·06 | 0·390 | 0·390 | 0·390 | 28·21 | 0·392 | 0·392 | 0·392 | 1·84 | |
| MnO | 0·86 | 0·012 | 0·012 | 0·012 | 0·86 | 0·012 | 0·012 | 0·012 | 0·06 | |
| MgO | 6·31 | 0·158 | 0·158 | 0·158 | 6·34 | 0·158 | 0·158 | 0·158 | 0·74 | |
| CaO | 2·45 | 0·044 | 0·044 | 0·044 | 2·46 | 0·044 | 0·044 | 0·044 | 0·21 | |
| $H_2O$ | 0·16 | — | — | — | — | — | — | — | — | |
| $H_2O$ | 0·03 | — | — | — | — | — | — | — | — | |
| Total | 99·54 | | | | | | | 2·564 | | |

Analyst: S. K. Babu.

$$F = \frac{12}{2{\cdot}564} = 4{\cdot}680$$

Sp. Gravity: 3·889.

$n\beta - 1{\cdot}775$ for sodium Light (determined by immersion method).

B/140

| | |
|---|---|
| Spessartite .. | 4·22 |
| Andradite .. | 1·10 |
| Grossularite .. | 2·20 |
| Almandine .. | 59·09 |
| Pyrope .. | 33·39 |
| | 100·00 |

The similarity is in favour of metamorphic origin for the above garnets from gneiss and amphibolite.

The average proportion of standard molecules in several rock types are given by Wright (1938).

| Rock types | Spessartite | Grossularite | Pyrope | Almandine | Andradite |
|---|---|---|---|---|---|
| Pegmatites .. | 47·1 | — | — | 41·8 | — |
| Granite .. | 36·0 | — | — | 56·8 | — |
| Garnets associated with contact action of siliceous rocks .. | 30·7 | — | — | 56·4 | — |
| Biotite schist, Leptites, S. India .. | — | 6·0 | 13·8 | 73·0 | — |
| Amphibole schists .. | — | 20·7 | 20·3 | 53·6 | — |
| Eclogites .. | — | 18·5 | 37·4 | 39·1 | — |
| Kimberlites & peridotites .. | — | 9·0 | 72·3 | 13·4 | — |
| Various basic rocks .. | — | 28·7 | 20·7 | 34·4 | 15·6 |
| Charnockites, Uganda | 1·3 | — | 35·8 | 41·2 | 21·7 |
| Calcarious contact rocks .. | — | 51·5 | — | — | 40·8 |

In the above table the analysed garnets can be placed between leptites and amphibole schists. B/108 corresponds to leptite and B/140 to amphibole schists but for the larger proportion of grossularite given in the table.

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# Floral Morphology and Embryology of Hydrophylax Maritima L.f.

BY

P. M. GANAPATHY

*Department of Botany, Presidency College, Madras-5*

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ABSTRACT

The floral morphology and embryology of *Hydrophylax maritima* L.f. has been studied. The study of the floral anatomy indicates that the sepals and stamens are vascularised by one set of traces and the petals and ovules, by another set of traces. The anther lobes remain distinct even at maturity. The hypodermal layer of the anther wall does not develop fibrous thickenings. The tapetum is secretory and remains uninucleate. Reduction divisions are simultaneous and the tetrads are tetrahedral and less frequently, isobilateral. The pollen is shed at the 2-celled stage. The ovule is unitegmic and tenuinucellate. The single archesporium directly functions as the megaspore mother cell. The embryo sac develops according to the *Polygonum* type. The basal antipodal cell exhibits conspicuous enlargement. Fertilization is porogamous. The endosperm is *ab initio* nuclear. The embryo develops according to the *Solanad* type. Seed is exendospermous. Strophiole persists in the seed.

*Introduction:*

The family Rubiaceae is amongst the plant groups that received embryological attention at quite early times. As early as 1837 Schleiden made brief observations of a general nature on the ovule in the Rubiaceae. Another early work (Hofmeister, 1858) added a few more observations to the study of Schleiden. However, the earliest comprehensive study on the embryology of Rubiaceae is that of Lloyd (1899, 1902). His treatise on the family includes significant information on the embryology of the genera *Asperula, Crucianella, Diodia, Houstonia, Richardsonia* and *Rubia*. His conclusions, though many of them have been modified by recent studies, threw much light on some of the interesting features of the family such as the nature of the nucellus, the occurrence of antipodal haustoria, the behaviour of the pollen tube, etc. The most thorough study of the embryology of the family is that of

Fagerlind (1936, 1937). Apart from revising some of the erroneous conclusions of Llyod, he has also described the embryology of *Galium, Ixora, Oldenlandia, Pavetta, Spermacoce, Vaillantia* etc. The other important embryological studies in the family include some detailed developmental studies of the integument and nucellus of *Coffea* (Houk, 1938); the development of embryo sac and embryo in *Dentella repens* and *Oldenlandia alata* (Raghavan and Rangaswamy, 1941); development of microsporangium, embryo sac and embryo in *Spermacoce hispida* and *Guettarda speciosa* (Raghavan and Srinivasan, 1941); gametogenesis and fertilization of *Stephegyne parviflora* (Ramam, 1954); and a note on the important embryological features of *Rubia cordifolia* and *Hamelia pratens* (Venkateswaralu and Rajeswara Rao, 1954).

*Material and methods:*

The material was collected in Madras and fixed in formalin-acetic-alcohol. The customary methods for dehydration and embedding were followed. Sections were cut 8-12μ thick and stained in Heidenhain's iron alum-haematoxylin. Erythrosin in clove oil or fast green in clove oil was used as counterstain. Serial transections 8μ thick were cut for the study of floral anatomy and stained in haematoxylin and safranin.

*General morphology of the plant:*

*Hydrophylax maritima* L.f., is a sea-shore plant with long creeping stems and thick glossy leaves. The stems run just below the surface of the sand and send up short leafy branches above. The leaves are set close together, those of a pair being joined by a rough membranous stipule.

The flowers are essentially tetramerous, actinomorphic, sympetalous, epigynous and perfect. The four sepals tend to be undiverged for a long distance at the base. Their aestevation in the bud is valvate. The four petals alternate with the sepals and are undiverged from one another for almost their entire length. The four epipepetalous stamens alternate with the mauve coloured petal lobes and are exserted on the throat of the corolla. The anthers contain four thecae all towards one side of the connective. The ovary is inferior, bilocular, with one unitegmic ovule in each cell. The fruit is triquetrous and has, at the top, four persistent sepals.

*Floral Anatomy:*

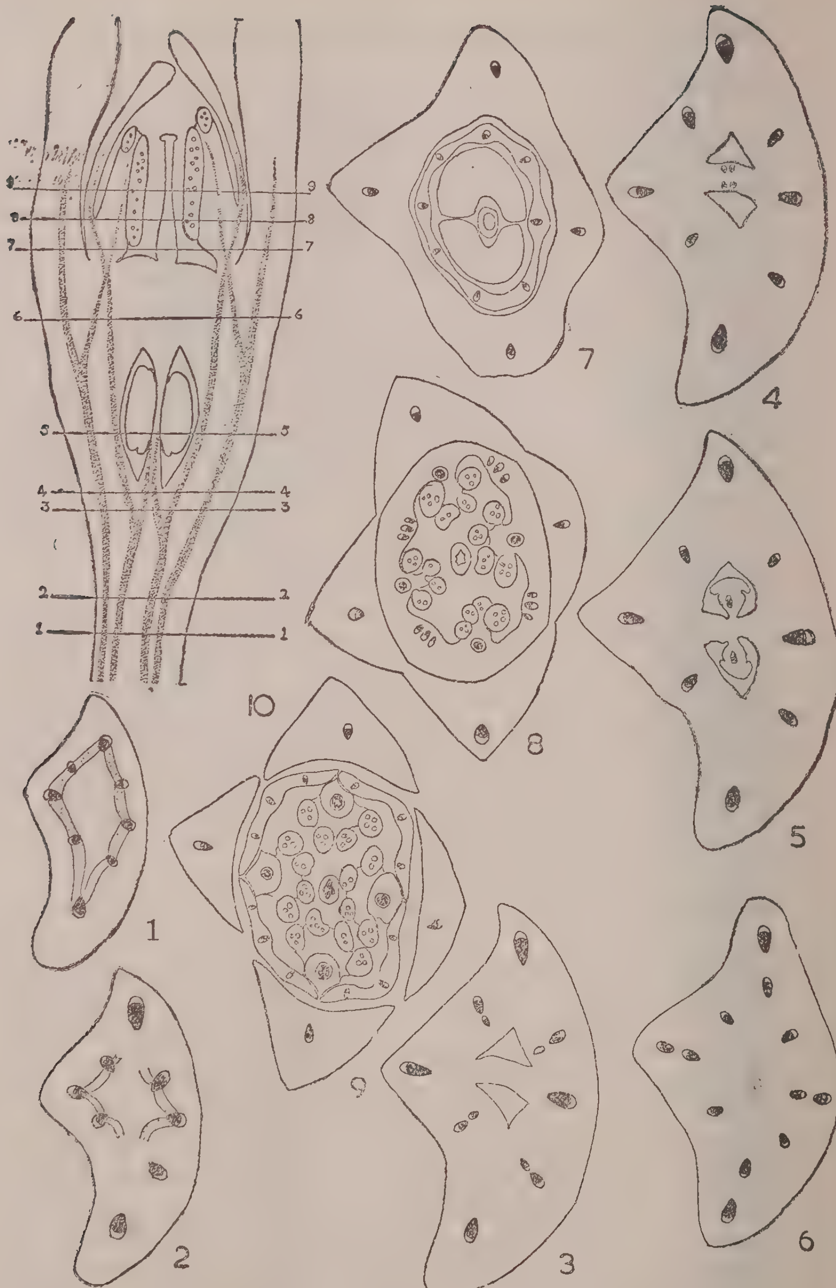
The vasculature in the pedicel appears in the form of an eustele, the individual bundles (8 in number) being arranged in the form of a ring. However, at this region, the inter-fascicular areas appear distinct from the ground tissue and exhibit histological characteristics of procambium (Fig. 1). The first set of traces to deviate from the ring are those that occupy the four corners of the inferior ovary. These traces constitute the sepal-stamen vasculature (Figs. 1-7). The inner set of four bundles, at a slightly higher level, bifurcate in the radial plane (Fig. 2). Thus at this stage, there are three sets of four bundles each—the outer (sepal-stamen traces), the middle, and the inner (Fig. 3). The latter converge towards the centre at the base of the septum (Fig. 4) and constitute the ventral bundles of the carpels. At higher levels in the septum, the pairs of ventral bundles, belonging to the respective carpels, fuse to constitute the vascular supply to the ovules (Fig. 5).

The middle set of bundles continue as such in the ovary wall till the level of insertion of the petals and undergo trifurcation before entering the respective appendages (Figs. 3-8). The sepal-stamen traces undergo bifurcation in the radial plane, somewhere in the top region of the inferior ovary (Figs. 6, 10). The outer set supplies the sepals and the inner, the stamens (Figs. 7-9). The bundles that supply the stamen soon become conspicuously concentric (Figs. 8, 9).

*Microsporogenesis and male gametophyte:*

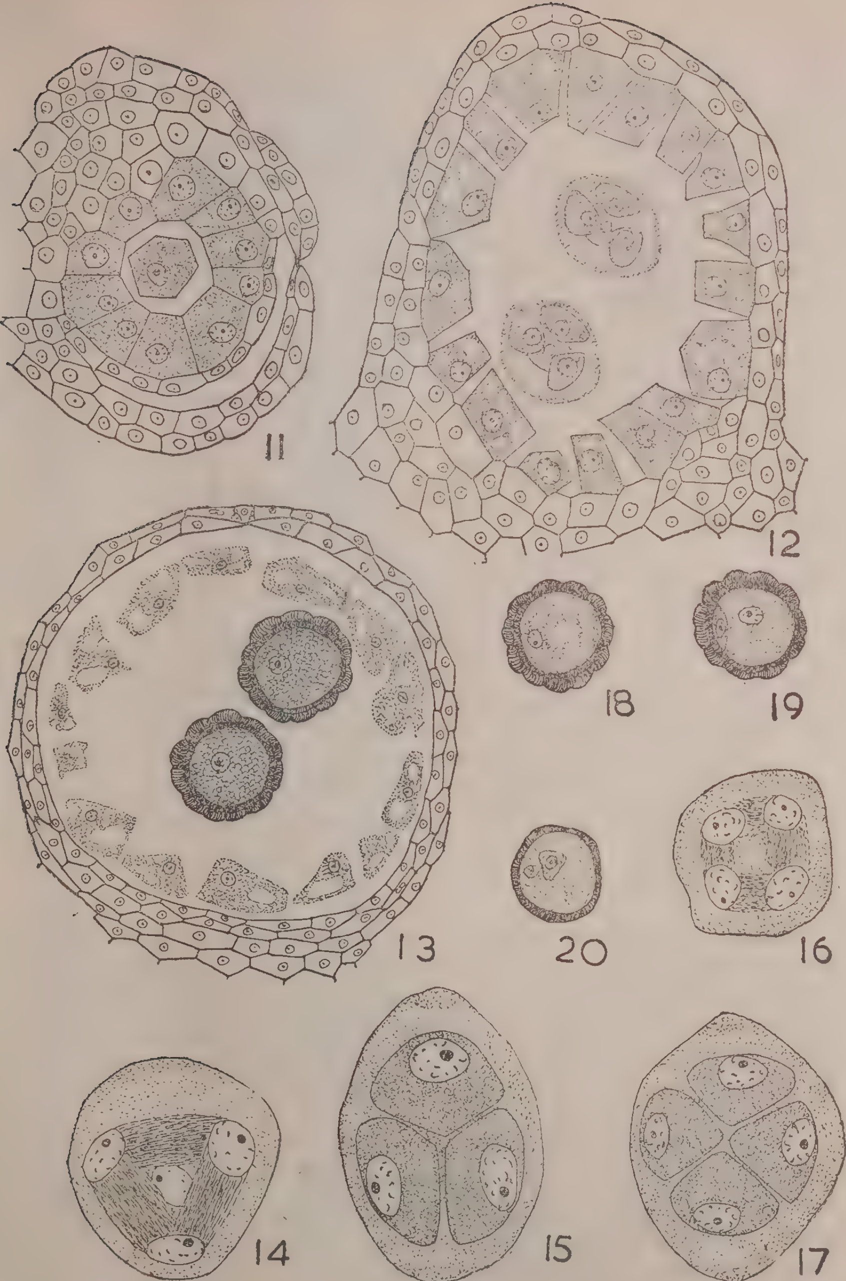
A young anther lobe consists of an outermost layer of epidermis, and two wall layers followed by an innermost layer of tapetum enveloping the sporogenous tissue (Fig. 11). The inner of the wall layers disintegrates and disappears during the meiotic divisions of the microspore mother cell, so that the tapetum comes to lie next to the sub-epidermal layer (Fig. 12).

The layer of the anther which is homologous with the endothecium does not develop the characteristic fibrous thickenings, but persists as such together with the epidermis in the mature condition (Fig. 13). The tapetal cells remain uninucleate throughout (Figs. 11-13). Towards the later stages in the development of pollen grains, the tapetal cells lose contact with each other, large vacuoles appear in the cytoplasm and the nuclei begin to show signs of degeneration (Figs. 12, 13).




Figs. 1-10

Figs. 1-9. Diagrams of successive transections of the flower to illustrate the course of vasculature. The approximate levels of these figures are shown by corresponding markings in Fig. 10. Figs. 1-6 × 18, Figs. 7-10 × 12.




FIGS. 11-20

Fig. 11. Transection of the anther locule $\times$ 835; Fig. 12. Same, about the time of the formation of microspore tetrads $\times$ 835; Fig. 13. Microspore stage $\times$ 405; Figs. 14-17. Stages in the formation of microspore tetrads $\times$ 1350; Fig. 18. Uninucleate microspore $\times$ 405; Fig. 19. 2-celled stage soon after formation $\times$ 405; Fig. 20. Mature pollen grain $\times$ 405.

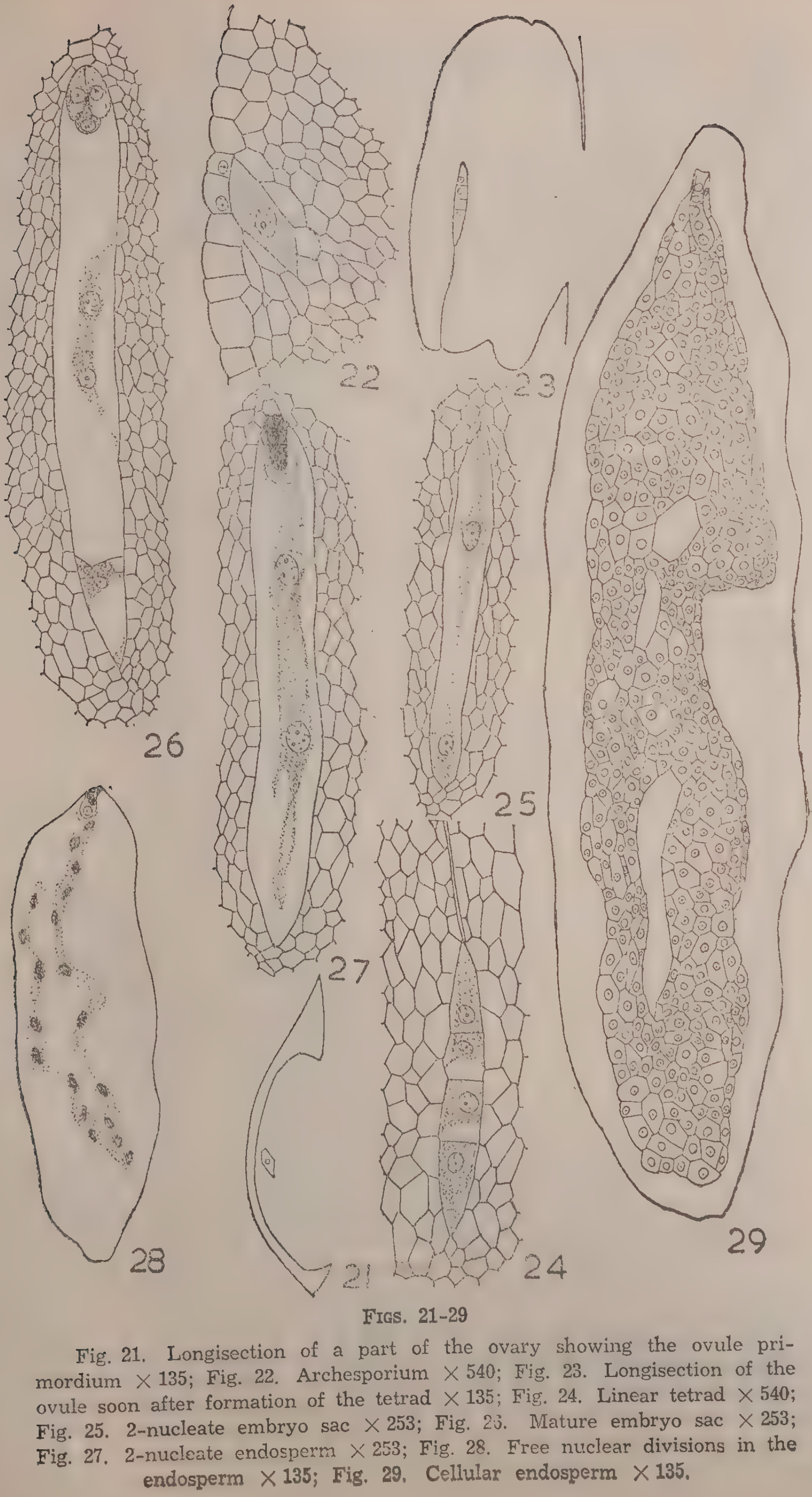
The microspore mother cells are compactly arranged and each cell is polygonal in shape with a prominent nucleus in dense cytoplasm (Fig. 11). The reduction divisions are simultaneous (Figs. 14, 16). The microspores are arranged tetrahedrally (Figs. 12, 15) and less frequently, isobilaterally (Fig. 17). The microspore released from the tetrad increases in volume. Its nucleus moves towards one side of the cell and undergoes mitosis *in situ*. This results in the formation of a small lens-shaped generative cell and larger vegetative cell (Fig. 19). After a time, the generative cell shifts its position so as to lie anywhere in the protoplasm of the vegetative cell (Fig. 20). The exine and the intine of the microspores are well developed and the former is finely pitted.

*Megasporogenesis and female gametophyte:*

The nucellus is much reduced and consists of a nucellar epidermis of few cells (Fig. 22). An archesporium differentiates in the hypodermal layer (Figs. 21, 22) and functions directly as the megaspore mother cell. A single massive integument develops from the ovular tissue, surrounding the nucellus proper (Figs. 22, 23). At about the time of formation of the tetrad, the integument attains considerable growth, enclosing a long narrow micropyle (Fig. 23). By this time, the layer of nucellar epidermis would have disorganised.

Another interesting feature in the ovule of *Hydrophylax* is a structure designated by Lloyd (1902) as strophiole. This structure develops as a narrow, discoid cushion-like outgrowth adpressing the abaxial side of the ovule and enclosing the vascular trace (Fig 40). The cells constituting this tissue become conspicuous by the accumulation of brownish contents.

The megaspore mother cell gives rise to a typical linear tetrad (Figs. 23, 23) of which the chalazal megaspore only develops into an 8-nucleate embryo sac (Figs. 25, 26). The maximum linear growth of the embryo sac is accomplished at the 2-nucleate stage (Fig. 25). The mature embryo sac presents conspicuously large linear measurement. The egg apparatus consists of synergids with tapering apical ends and hemispherical bases (Fig. 26). Of the three antipodals, the lowermost undergoes considerable increase in volume (Fig. 26).




FIGS. 21-29

Fig. 21. Longisection of a part of the ovary showing the ovule primordium $\times$ 135; Fig. 22. Archesporium $\times$ 540; Fig. 23. Longisection of the ovule soon after formation of the tetrad $\times$ 135; Fig. 24. Linear tetrad $\times$ 540; Fig. 25. 2-nucleate embryo sac $\times$ 253; Fig. 26. Mature embryo sac $\times$ 253; Fig. 27. 2-nucleate endosperm $\times$ 253; Fig. 28. Free nuclear divisions in the endosperm $\times$ 135; **Fig. 29. Cellular endosperm $\times$ 135.**

*Fertilization:*

Fertilization is porogamous. After penetrating the membrane of the embryo sac, the pollen tube passes between the egg and one of the synergids, destroying the latter in the process. The other synergid remains intact until some time after fertilization. The antipodals degenerate after fertilization (Fig. 27).

*Endosperm:*

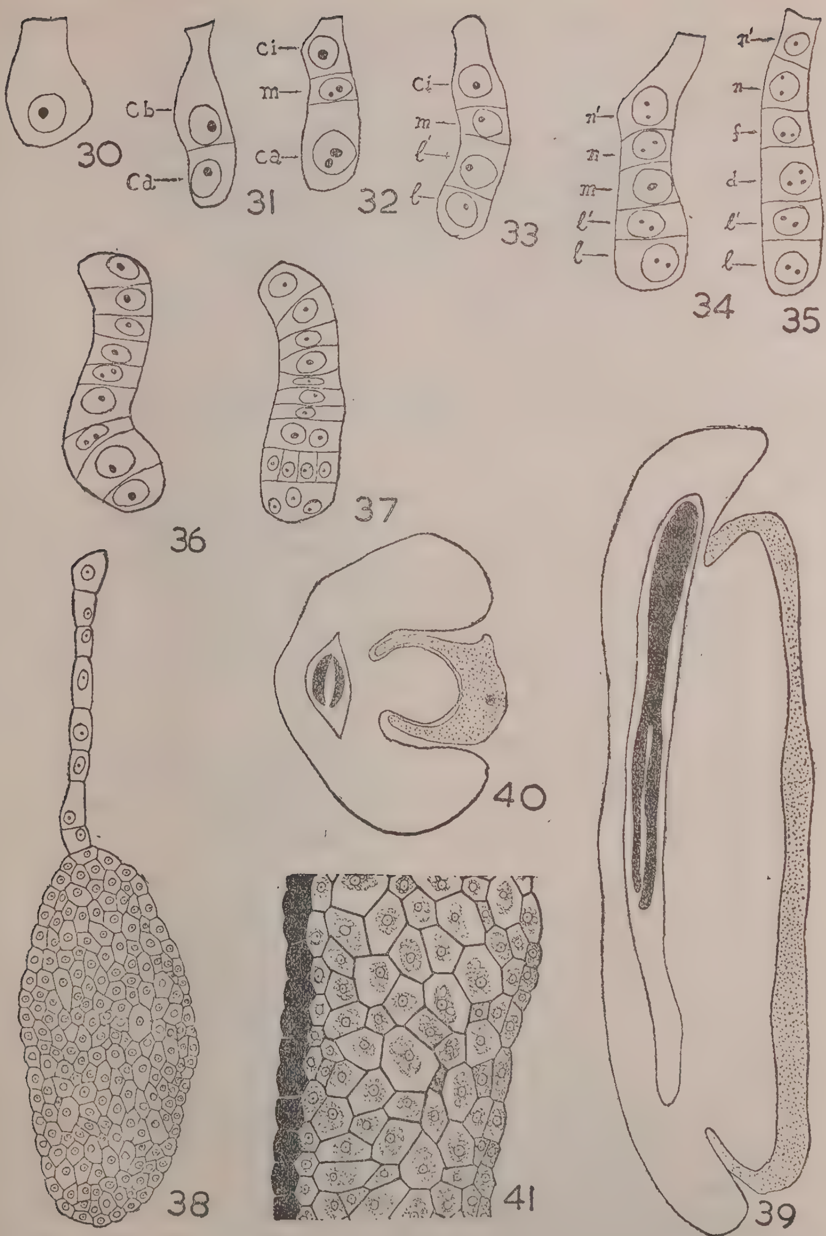
The division of the primary endosperm nucleus precedes that of the zygote. The first and subsequent divisions are not followed by the formation of walls (Figs. 27, 28). After a time, the nuclei at the micropylar and chalazal ends divide at a faster rate than in the middle region. The endosperm becomes cellular when the proembryo is in the filamentous stage (Fig. 29). With the development of the embryo, the endosperm tissue is fully used up (Fig. 39).

*Embryo:*

The first division of the zygote (Fig. 30) is transverse (Fig. 31). The terminal cell *Ca* and the basal cell *Cb*, both divide transversely to give rise to a 4-celled proembryo (Figs. 32, 33). These cells may be designated from the chalazal end as *l*, *l′*, *m* and *Ci*. (Fig. 33). *m* and *Ci* divide in a transverse plane to produce *d*, *f*, *n* and *n′* (Figs. 34, 35). By subsequent divisions, the tiers *l* and *l′* form the embryo proper and the remaining cells *d*, *f*, *n* and *n′* by one more transverse division form an eight nucleate suspensor (Figs. 36-38). Thus, the development of the embryo corresponds to the *Solanad* type. The mature embryo is very long with two cotyledons and a hypocotyl (Fig. 39). The embryo dissected from mature seeds exhibits a slight inequality in the size of the two cotyledons.

*Seed and fruit:*

In the majority of cases, only one of the ovules matures into seed, the other degenerating at various stages before fertilization. The mature seed consists of the remains of the strophiole and the thick integument (Figs. 39, 40). The cells of the integument are thick walled (Fig. 41). The epidermal cells of the integument become massive and retain the brownish impregnation (Fig. 41). The fruit is diamond shaped in cross section and is crowned by the four persistent calyx lobes.




FIGS. 30-41

Figs. 30-38. Successive stages in the development of the embryo, Figs. 30-37 × 540; Fig. 38 × 253; Fig. 39. Longisection of the mature seed × 18; Fig. 40. Transection of the mature seed × 18; Fig. 41. A part of the seed coat enlarged × 65.

*Discussion:*

It is of interest to note that in the development of the anther there is no fusion of the adjacent locules even at the time of shedding of pollen grains. The four microsporangia remain distinct and separate, from the time of initiation of the thecae to the maturation of the anther. As the study of microsporogenesis has not received any attention from the chief workers in the family, viz., Lloyd and Fagerlind, it cannot be said whether this feature is of general occurrence in the family. Nor there is any mention of this feature in the more recent studies (Raghavan and Srinivasan, 1941; Ramam, 1954; and Venkateswaralu and Rajeswara Rao, 1954).

The absence of fibrous thickenings in the sub-epidermal layers is another noteworthy character observed in the present study. Even in regard to this character again, the little attention that microsporogenesis has received by previous workers does not make allowance for any comparison. In *Spermacoce hispida* (Raghavan & Srinivasan, 1941), the anther lobes figured by the authors do not show any fibrous thickening. But, in *Stephegyne parviflora* (Ramam, 1954), the development of normal fibrous thickening has been described. In view of the variability of the presence of an endothecium, further investigations on a wide range of representatives of this family may yield valuable information as to the probable systematic value of this feature.

The occurrence of tapetal cells which remain uninucleate throughout is another significant feature in the anthers of *Hydrophylax*. This feature in the family seems to be of frequent occurrence, as it has been reported in *Stephgyne* (Ramam, 1954), *Hamelia patens* and *Rubia cordifolia* (Venkateswaralu & Rajeswara Rao, 1954). In *Spermacoce*, however, Raghavan and Srinivasan (1941) report a binucleate tapetum, the nuclei of some of which undergo fusion to attain a secondary uninucleate condition. Further intensive studies in the family should decide the relative frequency of the occurrence of this feature.

The distinction between nucellus and integument in the family is not very clear. Schleiden (1837) wrote that in Rubiaceae the ovules are naked. Lloyd (1902) demonstrated the presence of an integument in all the genera studied by him, but erroneously interpreted the ovules of *Houstonia* to be ategumentary. Fagerlind (1937) however has shown that even in *Houstonia* the ovule is

tegmic. Furthermore, he has presented a series of stages showing the phylogenetic reduction of the nucellus in the family. According to this series, the nucellus in *Hydrophylax* conforms more or less to the beginning stages. The cytological studies of Raghavan and Srinivasan (1941) in the family confirms the reduction series proposed by Fagerlind. These authors, in addition, have illustrated alternative schemes of nucellar reduction prompted and corroborated by the study of chromosome number in the family.

Fagerlind (1937) has described two types of antipodal apparatus in the Rubiaceae. In the first type, the antipodals become swollen and often exhibit nuclear divisions, as in *Phyllis* (Fagerlind 1936). In the second type, only the basal antipodal cell enlarges and acts as a haustorium, as in *Asperula, Callipeltis, Diodia* and *Galium* (Fagerlind 1937). *Hydrophylax* distinctly belongs to the second type. Raghavan and Rangaswamy (1941) have described a third type of antipodals in *Dentella repens.* In this species, the antipodals do not enlarge, but degenerate long before fertilization. The only other reported instance of such a behaviour of the antipodals is in *Stephegyne parviflora* (Ramam, 1954).

Strophiole is present in a number of genera of the family. Lloyd (1902) first described this structure in the various species of *Diodia* investigated by him. Discussing its morphology, he comments that it is the "seat of special metabolic activity during the growth of the embryo and the endosperm". On the other hand, Raghavan and Srinivasan (1941) opine that it controls in some way the ingress of the pollen tube into the micropylar canal. This tissue has its origin, of course, at very early stages; but appreciable development takes place only after fertilization. This observation, together with the fact that the carpellary trace runs along the length of the strophiole, seems to justify the suggestion of Lloyd.

Raghavan and Srinivasan (1941) do not attach any phylogenetic significance to the strophiole, because according to them, "it is present in most genera irrespective of whether the genera are primitive or advanced, determined from apt considerations like the nature of the nucellus". A study of the literature on the family indicates an association between the presence of the strophiole and the number of ovules in the ovary. Strophiole has been recorded in *Ixora, Leptodermis, Pavetta, Richrdsonia* (Lloyd 1902), *Guettarda, Spermacoce* (Raghavan & Srinivasan, 1941)

and *Hydrophylax* (present study). All these genera have a solitary ovule in each cell. Thus, there appears to be an association of the strophiole with representatives possessing a reduced number of ovules. Though this association in itself, does not indicate any phylogenetic significance, it may be said that intensive comparative study in the family may throw light on the physiology and phylogeny of this structure.

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# Sex Changes in the Wood-boring Pelecypod *Bankia indica* Nair

BY

N. Balakrishnan Nair, *
*Zoology Research Laboratory,*
*University of Madras*

(Received for publication on 27th March, 1956)

ABSTRACT

*Bankia indica* is essentially protandric, nearly all females passing through a preliminary functional male phase before reaching the female stage. It is also suggested that the female after a functional Spawning phase can revert to the male phase and produce spermatozoa.

The wide variation in the expression of sexuality among bivalves is noticeable in teredines also. Earlier workers like Quatrefages (1849), Pelseneer (1906), and Nelson (1922), have observed unaccountable disparities in the proportion of the sexes in this group. It was Yonge (1926) who suggested the interference of the phenomenon of protandry when he obtained two hermaphrodites of *T. norvegica* changing from male to female. Sigerfoos (1908) found many hermaphrodites among young individuals of *Bankia gouldi* and suspected that protandry is normal in that species. Kofoid and Miller (1927) observed that males of *Teredo navalis* in San Francisco Bay are commonly smaller than females but found no evidence that actual change of sexual phase might occur.

A succession of a functional male and female phases was conclusively demonstrated by histological studies conducted by Coe, (1933, 1933 a, 1934, 1935). In the first of these papers Coe reported an actual transition from the functional male phase to the functional female phase in about half the number of small individuals infesting ropes in New Haven harbour. The second paper (1933 a) gave detailed descriptions of the transformations of the primitive

*Present address:—Zoology Department, Alagappa College, P.O., Ramnad District.

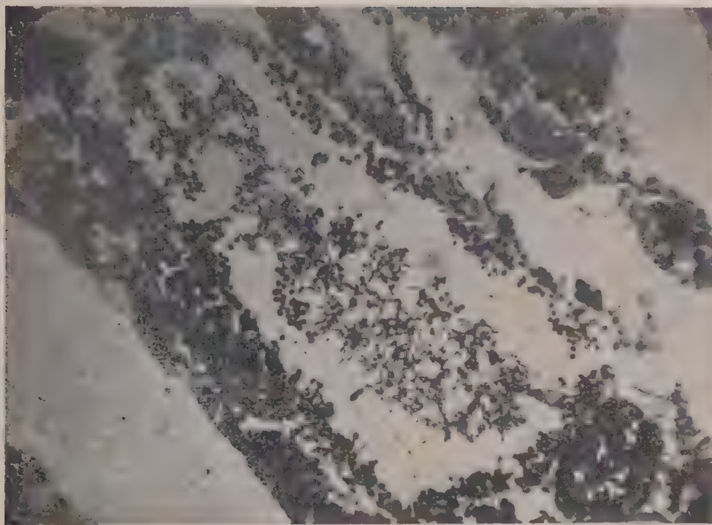
bisexual gonad of the very young individuals through an initial male phase and thence to female phase towards the end of the breeding season. A further transformation of the female phase to another male phase with details of cellular changes involved was reported in the third paper of the series (1934). Grave and Smith (1936) found that the transformation from female to male phase may occur abruptly during breeding season as well as in the recuperation period and that gametes of both types may be produced in the same follicle and that these are capable of self fertilisation.

The results briefly reviewed above relate to forms belonging to temperate waters where the seasons are distinctly marked. Very little is known regarding this phenomenon of sex change in the tropical forms. It is well known that in the tropics animals breed right through the year and also exhibit peak reproductive activity during some part of the year. It will be of interest therefore to study the sequence of sexual phases in different teredines along with the histological changes the gonads undergo during the life in relation to the different times of the year. To ascertain whether there is protandry in this species the sexual condition of three samples consisting of more than 633 specimens were examined and grouped according to their sizes. The gonads of about 125 were sectioned while the gonads of the rest were teased and examined microscopically. The length of the burrow was taken as the length of the animal. The results are tabulated below.

Table showing the sexual conditions of the specimens examined.

| Length in mm. | True males. | Ambisexual males. | Hermaphrodites. | Females. | Total. |
|---|---|---|---|---|---|
| 1- 20 | ? | 60 | — | — | 60 |
| 20- 50 | 9 | 169 | 2 | 5 | 185 |
| 50-100 | 16 | 77 | 7 | 211 | 311 |
| 100-150 | 1 | 16 | 1 | 27 | 45 |
| 150-200 | 1 | 9 | — | 17 | 27 |
| Above 200 | 1 | — | 1 | 3 | 5 |

Of the 60 specimens examined in the first size group none showed any ovocyte in the gonads. The smaller ones showed the primary gonial cells and the follicle cells, and as the length increased these



PHOTOMICROGRAPH I × 400
Section of the gonad in the active male phase showing spermatozoa and spermatogonia.

PHOTOMICROGRAPH II × 280
Section of the hermaphrodite gonad which is changing from the male phase to the female phase. The lumen is filled with spermatozoa, and a few dividing spermatogonia as seen between the developing ovocytes. The male phase is almost completed.

primary gonia multiplied rapidly and in the 10 mm. ones the formation of primary spermatocytes and spermatids were clear. In the 15 mm. long individuals the follicle cells have been found to undergo cytolysis and spermatozoa occupied the central lumen of the follicle. Search, however, did not show the presence of any distinguishable ovocytes at the cortical region.

In the second size group out of 185 forms there were 9 forms which had very few or no ovocytes along the walls of the follicles. Most of the residual cells appear to be spematogonia indicating that the succeeding sexual phase will also be male representing the 'true males' of Coe (1933). The 169 males are those forms in which the gonads show a highly variable proportion of spermatogenic and ovogenic cells. Serial sections of many of these showed a cortical layer of young ovocytes and spermatogenic cells, and the lumen of the follicle containing spermatozoa. In the smaller ones in this length group ovocytes were inactive and very small but in the larger ones as spermatogenesis continued the ovocytes grow in size and begin the deposition of yolk and become visible. There were only two hermaphrodites (ambisexual) capable of concurrently producing gametes of both sexual types in the same follicle. Five specimens were females and according to Coe (1933 a) such females make their appearance by the omission of the initial male phase.

In the next size group there were 211 females out of 311 specimens examined. Evidently these were the forms which have changed their sex from the initial bisexual male phase. In the last three size groups the true males continued to be present and these are supposed to remain as males for the rest of their lives but in view of the presence of a few ovocytes in the cortical regions of the follicles it is not improbable that a later reversal may sometimes occur. In these last size groups the females are more numerous than males but the ratio, however, is not so different as reported by earlier authors.

Thanks are due to Prof. C. P. Gnanamuthu for guidance during the course of the work.

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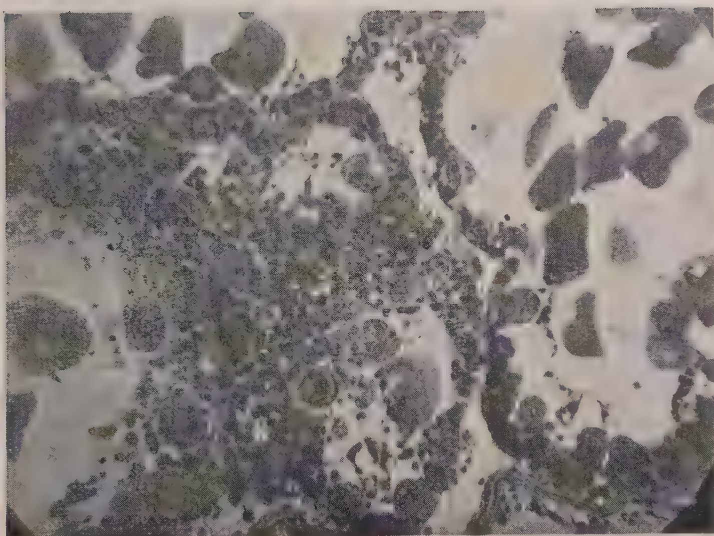

PHOTOMICROGRAPH III × 400
Section of the gonad in the active female phase.

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# The Systems: Glycol—n—Butyl Alcohol—Water and Glycol—Isobutyl Alcohol—Water

BY

K. L. Lakshminarasimhan,[1] S. Gopalan[2] and G. S. Laddha
*Alagappa Chettiar College of Technology,*
*University of Madras.*

(Received for publication, April 14, 1956)

ABSTRACT

The present work was undertaken to evaluate the performance of n-butyl alcohol and isobutyl alcohol as solvents for the extraction of ethylene glycol from acqueous solutions in terms of the ternary equilibrium and tie line data for the systems ethylene glycol-n-butyl alcohol-water and ethylene glycol-isobutyl alcohol-water both at 30°C. A comparison of the equilibrium data with previously published data for the systems glycol-n-amyl alcohol-water, glycol-n-hexyl-alcohol-water and glycol-furfural-water indicates that n-butyl alcohol and isobutyl alcohol are better extractive solvents than furfural, n-amyl alcohol and n-hexyl alcohol which have been studied previously.

In connection with a study of the extraction of ethylene glycol from aqueous solutions, Laddha and Smith (1948) studied the systems, ethylene glycol—n-amyl alcohol-water and ethylene glycol—n-hexyl alcohol-water at 20°C. Conway and Norton (1951) in their study of the system ethylene glycol-furfural and water observed that furfural was a better solvent for extraction than n-amyl alcohol and n-hexanol. The present study of the systems ethylene glycol—n-butyl alcohol-water and ethylene glycol-isobutyl alcohol-water at 30°C indicates that both n-butyl and isobutyl alcohol are better solvents than furfural although in the case of these solvents

1. Present address: Sindhri Fertilizers and Chemicals Ltd., Sindhri
2. Present address: Standard Vacuum Oil Co., Ltd., Madras.

also the ratio of glycol concentration in the solvent phase to that in the aqueous phase is lower than unity.

The results are summarised in Tables I and II and Figures 1 and 2.

TABLE I

Equilibrium Data for the System Ethylene Glycol—n-Butyl Alcohol—Water at 30°C.

| Solubility Data | | | Weight Percent | | |
|---|---|---|---|---|---|
| Glycol | n-Butyl Alcohol | Water | Glycol | n-Butyl Alcohol | Water |
| — | 79·4 | 20·6 | — | 7·1 | 92·9 |
| 9·85 | 64·9 | 25·25 | 14·87 | 7·24 | 77·89 |
| 17·20 | 50·25 | 32·55 | 20·05 | 7·66 | 72·29 |
| 21·90 | 37·20 | 40·90 | 26·31 | 18·20 | 55·49 |

Tie Line Data

| Alcohol Phase Composition weight % | | | Water Phase Composition weight % | | |
|---|---|---|---|---|---|
| Glycol | n-Butyl Alcohol | Water | Glycol | n-Butyl Alcohol | Water |
| 2·10 | 76·35 | 21·55 | 7·73 | 7·10 | 85·27 |
| 4·8 | 72·50 | 22·70 | 14·00 | 7·12 | 78·88 |
| 10·90 | 62·20 | 25·90 | 23·60 | 9·40 | 67·00 |
| 13·80 | 58·40 | 28·8 | 25·70 | 12·05 | 62·25 |

TABLE II

Equilibrium Data for the System Ethylene Glycol—Isobutyl Alcohol—Water at 30°C.

| Solubility Data | | | Weight Percent | | |
|---|---|---|---|---|---|
| Glycol | Isobutyl Alcohol | Water | Glycol | Isobutyl Alcohol | Water |
| 8·11 | 84·01 | 7·88 | 7·00 | 20·36 | 72·64 |
| 16·24 | 75·86 | 7·90 | 11·20 | 22·70 | 66·10 |
| 26·21 | 62·72 | 11·07 | 13·32 | 24·30 | 62·38 |
| 29·00 | 55·52 | 15·48 | 22·19 | 35·77 | 42·04 |
| 27·95 | 48·03 | 24·02 | 25·64 | 42·46 | 31·90 |

The Line Data

| Alcohol phase composition weight % | | | Water Phase Composition weight % | | |
|---|---|---|---|---|---|
| Glycol | Isobutyl Alcohol | Water | Glycol | Isobutyl Alcohol | Water |
| 2·9 | 79·6 | 18·5 | 10·7 | 7·8 | 82·5 |
| 5·5 | 75·8 | 19·7 | 16·5 | 8·2 | 75·3 |
| 7·4 | 72·95 | 20·65 | 19·4 | 8·7 | 72·90 |
| 11·0 | 66·45 | 22·55 | 26·0 | 10·8 | 63·20 |
| 14·4 | 60·20 | 25·40 | 28·4 | 14·0 | 57·6 |

*Purity of Materials*

1. Ethylene Glycol. Ethylene glycol used had a boiling range of 193·0—195·5°C with the major portion boiling at 195·5°C and a density at 30°C of 1·1065. The corresponding literature values for pure ethylene glycol are 197·85°C and 1·1066 (1955).

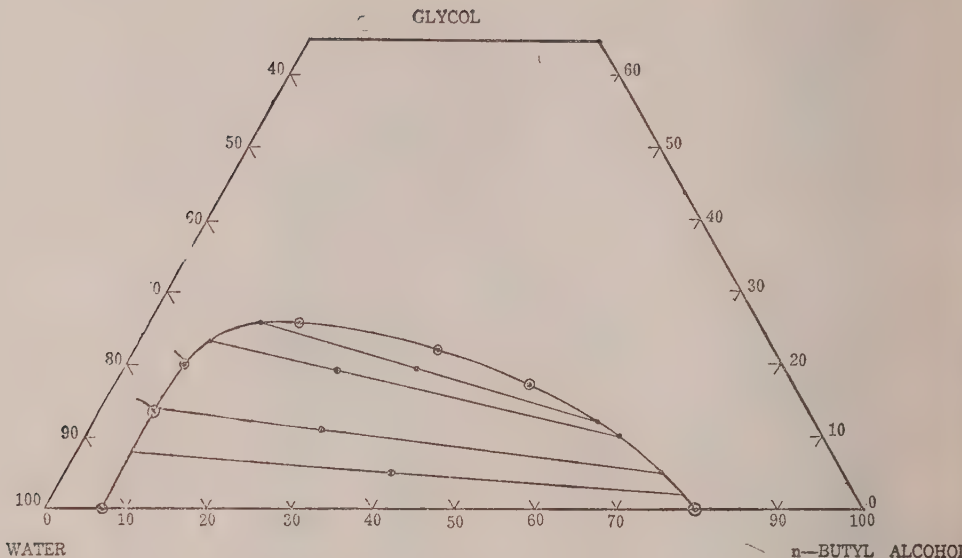


FIG. 1
Ethylene Glycol-n-Butyl Alcohol-Water system.

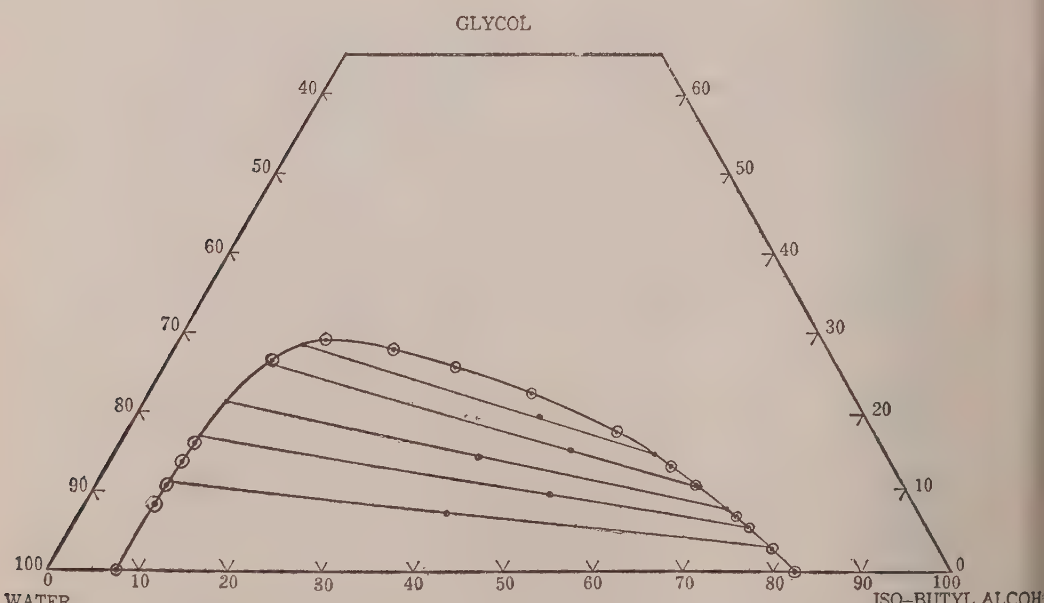


FIG. 2
Ethylene-Glycol-Water-iso-Butyl Alcohol system.

2. n-Butyl alcohol. n-Butyl alcohol supplied by E. Merck, Darmstadt was fractionated and the fraction boiling between 117-118°C was used. It had a density of 0·8020 at 30°C. Published values for n-butyl alcohol are 117·7°C and 0·80206 respectively (1955).

3. Isobutyl Alcohol. Isobutyl alcohol supplied by E. Merck, Darmstadt was fractioned and the fraction boiling between 107·5° to 108°C was used. It had a density of 0·7947 at 30°C. The corresponding literature values are 107·89°C and 0·7944 at 30°C respectively (1955).

4. Distilled water from the laboratory supply was used.

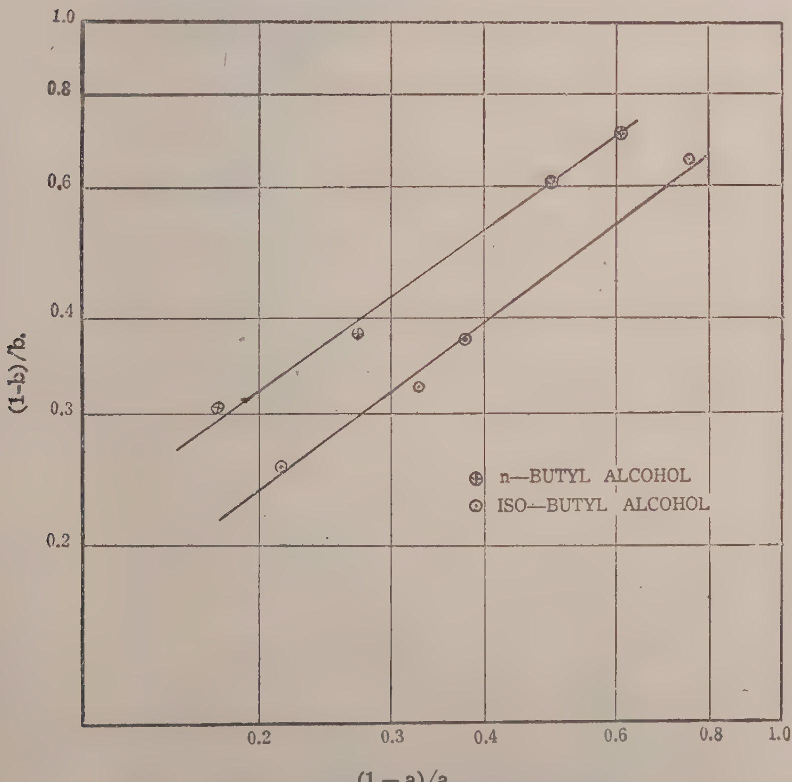


FIG. 3. Correlation of Tie line Data.
(a) Weight fraction water in water phase.
(b) Weight fraction alcohol in alcohol phase.

*Experimental Procedure*

The equilibrium and phase distribution data were determined at 30°C. The solubility data were determined by titrating known mixtures of alcohol and glycol or water and glycol with the third component until turbidity appeared over the entire solution. The tie lines were located by preparing mixtures of the three components which would give two phases at equilibrium. After vigorous agitation the mixtures were placed in the constant temperature bath at 30 ± 0·1°C for a minimum period of four hours when the two phases which separated were clear. The individual phases were, then, separated and weighed. The composition of each phase, was then, evaluated by solution of the necessary material balance equations. In this way the extremities of the tie lines were determined in each case. The compositions of the initial mixtures are indicated by circles within the two phase region in Figures 1 and 2.

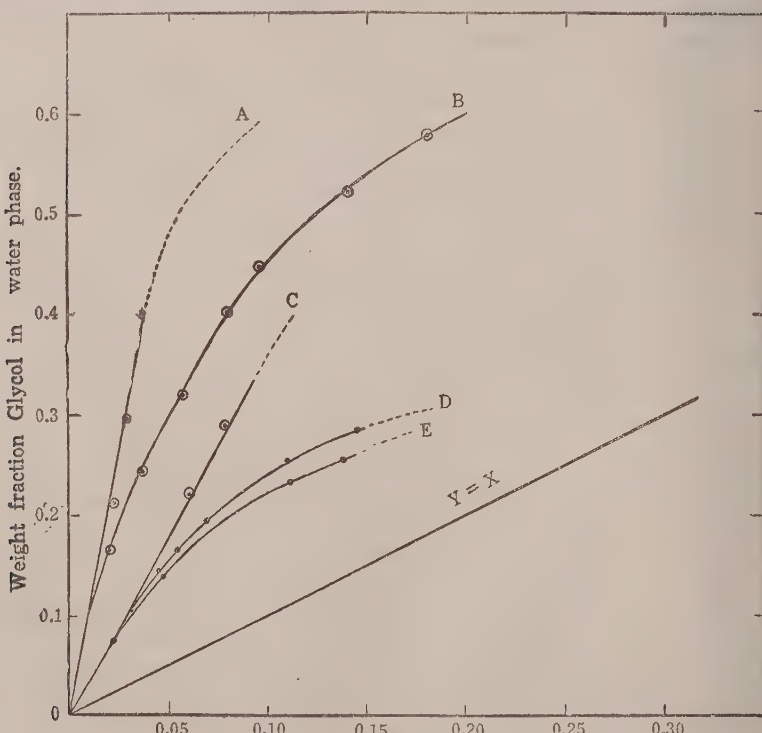


FIG. 4. Distribution of Glycol in water and Solvent phases.
A. n.-Hexyl alcohol, B. n-Amyl alcohol,
C. Furfural, D. iso-Butyl alcohol, E.n-Butanol.

### *Solubility Data*

The solubility curves for n-butyl alcohol and isobutyl alcohol are shown in Figs. 1 and 2. The data are presented in tables I and II. The maximum glycol content in a two phase system with n-butyl alcohol is 26% while with isobutyl alcohol is about 29% by weight.

### *Tie Line Data*

The composition of alcohol and water phases at equilibrium at 30°C are shown by the tie lines in Figs. 1 and 2. Among the various methods recommended for smoothing and interpolation of phase distribution data, the one suggested by the Othmer and Tobias is illustrated in Fig. 3. (1942).

In Fig. 4 the weight fraction of glycol in water phase is plotted against the weight fraction of glycol in the solvent phase. The curves in this figure give a comparison of the ability of the solvents to extract glycol from aqueous solutions. The curves for n-amyl alcohol and n-hexyl alcohol are taken from the data of Laddha and Smith (1948) while the curve for furfural is drawn from the data of Conway and Norton (1951) and these are compared with the curves for n-butyl alcohol and isobutyl alcohol plotted from the data presented in this paper. It is observed that n-butyl alcohol and isobutyl alcohol are better solvents than furfural although in the case of these solvents also, the ratio of glycol concentration in solvent phase to that in the water phase is less than unity.

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# Addition to the Sponge Fauna of Madras [1, 2]

BY

M. A. Ali,[3]

*University Zoological Research Laboratory,*
*Madras-5*

ABSTRACT

Ten species of Monaxonid sponges are described from the Madras Harbour and Royapuram area. Of these, *Prostylissa arcotti* and *Reniera delicatula* are new to science and *Lissodenderyx similis* Thiele is recorded for the first time from Indian waters.

## *Introduction*

The sponges from the Gulf of Manaar on the southern Madras coast have received considerable attention from several authors (Carter, 1880, 1881; Dendy, 1887, 1889, 1905; Burton & Rao, 1932; Burton, 1937; and Rao, 1941).

The sponge fauna of the Coramandal coast, on the other hand, has received little attention from workers in this field with the exception of Annandale (1914-1915), who described 3 new species from the Madras Harbour and 3 from the Chilka Lake. Due to the sandy nature of this coast, the sponge fauna is poor except in places like the Madras Harbour and the adjoining Royapuram area where the stonework of the former and the rocky nature of the latter provide good support for the sponges to attach and grow. In view of the abundance of sponges in this area and the paucity of literature regarding them it was felt that a taxonomic survey would be worthwhile.

The sponges collected were fixed in 5% formalin and preserved in 70% alcohol or methylated spirit. The larger specimens were dried. Hydrofluoric acid was used for desilicification. Paraffin and

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2. Part of the thesis submitted to the University of Madras for the degrees of Master of Science.

3. Author's present address: Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C., Canada.

celloidin were used in preparation of histological sections which were stained with Delafield's and Heidenhein's haematoxylin. To examine the spicules, pieces of sponge were teased and boiled with nitric and sulphuric acids, centrifuged and washed with distilled water a number of times. The spicule dimensions given are average measurements. In a few instances the sizes of extreme forms are given.

The scheme of classification suggested by Dendy (1905) and Burton (1937) is followed in this paper

*Account of the sponges*

*Order Tetraxonida*

*Group Monaxonida*

*Family Haplosceridae*

*Genus Pachychalina*

*Pachychalina multiformis* var. *manarensis* Dendy

*Pachychalina multiformis* var *manarensis* Dendy (1889).

Two specimens were taken from a fisherman's net, north of Madras.

*Size*: 120 mm. in length, diameter of the branches 7 mm. to 15 mm.

*Colour*: Brownish in living condition as well as after preservation.

*Spicules*: Curved oxea, 0·082 mm. by 0·0038 mm.

*Reniera delicatula* sp. nov. (Figs. 1 & 4).

*Diagnosis*: Sponge fragile and compressible; consisting of irregularly branching tubes, widely open at the end. Skeleton formed of a triangular meshed reticulation of oxea, which are joined at the tips by spongin. Oxea are slender, slightly curved and sharp-pointed, ending abruptly and measuring about ·124 mm. by ·008 mm.

*Occurrence*: Found abundantly on the side walls of the boat basin of the Madras Harbour and also on the bottom of the boats tied there for long periods. Sometimes they are found attached to the shells of dead molluscs. They do not occur in Royapuram.

*Description:* The body consists of a clump of about twenty tubes (Fig. 1), all rising from a common basal position. There is a great variation in the size of this sponge, ranging from 50 mm.-long tubes to 120 mm.-long ones. The diameter of the tubes also varies from 2 mm. to 10 mm. Oscula are found at the tip of the tubes and are usually very wide, their diameter being 3 mm. to 5 mm. The *Reniera* tubes exhibit a great deal of lateral fusion; in some cases it is so extensive that the individuality of the tubes is marked only by the oscula. Tube walls are quite thick. Sponge is very soft and fragile, and is easily torn. Colour in the living condition as well as in spirit is light yellowish brown. The smaller sponges, however, are cream coloured when alive.

Sub-dermal cavities of medium size underlie the thin dermal membrane. From these, narrow afferent canals extend radially into the wall of the sponge. Corresponding radial afferent canals open directly into the oscular apertures of these canals close together. Outer surface of a well-preserved sponge, when examined, is found to be minutely conulose, conuli being not very prominent. Though these sponges were collected and examined throughout the year, larvae were never found.

*Skeleton:* Skeleton is typically renieroid reticulum; meshes are square; the sides are unispicular and of the same length, transparent spongin is found at the nodes. Spicules (Fig. 4) are *oxea* and are slightly curved and do not have tapering tips. They measure 0·124 mm. by 0·008 mm. In the present case the tube wall was not found to contain any polyspicular tracts.

This harbour sponge undoubtedly belongs to the genus *Reniera* as may be seen from the nature of the skeleton; appearance and texture of the sponge.

Ridley and Dendy (1887) and Topsent (1904) observed that the specimens belonging to this genus collected by them from the North Atlantic and Mediterranean regions had elongated, slender tubes which were about 7 to 10 mm. in diameter. They also observed that these sponges were stipitate and that in addition to the reineroid reticulum, longitudinal polyspicular tracts were present.

In the present case it is seen that the spicule shapes and measurements are different from those of the closely related species *Reniera implexa* described by previous authors (Schmidt, 1868; Ridley and Dendy, 1887; Row, 1911; Wilson, 1925). In the Mediterranean sponge described by Ridley and Dendy (1887), the oxeas

measured 0·138 mm. by 0·007 mm. and in the North Atlantic specimens the recorded range is from 0·160 mm. by 0·006 mm. (Ridley and Dendy, 1887) to 0·2 mm. by 0·007 mm. (Topsent, 1904). In Dendy's (1905) specimens from Ceylon the multispicular fibres are loose, feeble and sparsely present. Roy's (1911) Red Sea sponge resembled the Mediterranean form.

In view of the above-mentioned features of this sponge and the differences between this and other known members of the genus *Reniera*, the present form is considered a new species and named *Reniera delicatula.*

*Genus Oceanapia*
*Oceanapia arenosa* RAO

*Oceanapia arenosa*: Rao, H. S. (1941)

Found attached to submerged rocks in the Royapuram area, 1 or 2 feet below the low-tide watermark. A few specimens were also collected from the stonework of the Madras Harbour below the low-tide watermark.

*Size*: 70 mm. by 50 mm.

*Colour*: Pale yellowish when alive, turns whitish on preservation.

*Spicules*: Oxeas: slightly curved and tapering. 0·15 mm. by 0·0054 mm.

*Genus Callyspongia*
*Callyspongia diffusa* RIDLEY

*Cladochalina diffusa*: Ridley, S.O. (1884)

*Callyspongia diffusa*: Rao, H. S. (1941)

*Size*: 100 mm. in height, diameter 10 mm.

*Colour*: Violet or yellowish brown in the living condition: fades slightly on preservation.

*Spicules*: Oxeas; slightly curved, without tapering but pointed extremities. 0·09 mm. by 0·0054 mm.

*Family Desmacidonidae*
*Section Myxilleae*
*Genus Tedania*
*Tedania nigrescens* SCHMIDT

*Reniera nigrescens*: Schmidt, E.O. (1862)

*Tedania digitata*: Gray, G. E. (1867)

*Tedania nigrescens*: Burton, M. and Rao, H. Ṡ. (1932)

*Tedania nigrescens*: Burton, M. (1937)

Twenty-five specimens belonging to this species were collected from the Royapuram area. Great variation in colour, size and spicule measurements is seen.

*Size*: 30 mm. to 120 mm. by 40 mm. to 80 mm. Average-sized specimen being 50 mm. to 80 mm. by 50 mm. to 65 mm.

*Colour*: Deep red or greenish to light greenish-yellow in life, changes to dull greyish; yellow on preservation.

*Spicule measurements* (average sizes)

Styles: 0·22 mm. by 0·008 mm.
Tylotes: 0·14 mm. by ·0054 mm.; diameter of head 0·0081 mm.
Onychata: 0·15 mm. by 0·0027 mm.

*Genus Lissodendoryx*

*Lissodendoryx similis* THIELE

*Lissodendoryx isodictyalis*: Thiele, Z. (1899).

*Lissodendoryx leptoderma*: Topsent, E. (1897)

*Lissodendoryx isodictyalis*: Topsent, E. (1897)

*Lissodendedoryx similis*: Burton, M. and Rao, H. S. (1932)

This sponge occurs in small numbers, both in the Madras Harbour as well as Royapuram area. It is found encrusting on the side walls of the harbour and the rocks in the Royapuram area.

Specimens were fixed in Bouin's, embedded and sectioned in order to study the anatomy fully and it was found that the dermal membrane, mesenchyme, canal system, skeleton as well as general histology were found similar to those of *Esperella* (Wilson, 1894) and *Halichondria* (Dendy, 1891).

This species was recorded by Topsent (1897) from Amboina, Carter (1882) from the West Indies and Burton and Rao (1941) from Mergui Archipelago. This is the first record of this species from India.

*Size*: 65 mm. by 47 mm. Surface is very uneven (Fig. 2) and texture is very soft and friable. Oscula are small and inconspicuous, scattered all over the surface of the sponge. Oscula measure about 0·9 mm. in diameter.

*Colour*: In the living condition it is orange in colour, which fades to greyish white in spirit.

*Skeleton*: Reticulate fibres made up of spicules (styles) which are in bundles. There is very little spongin in the skeleton which is chiefly spicular.

*Spicules* (Fig. 5): Styles are stout, bent slightly near the blunt end; 0·176 mm. by 0·0081 mm. Tylotes are slightly slender, with prominent heads; 0·17 mm. by 0·005 mm. Head's diameter is 0·0081 mm.

Microscleres: Isochelae are arcuate with tridentate heads and curved shafts. Measure 0·03 mm. in length.

Sigmas are few in number. Measure 0·02 mm. in length.

*Section Mycaleae*
*Genus Mycale*

*Mycale mytilorium* ANNANDALE

*Mycale mytilorium*: Annandale, N. (1914)

*Mycale mytilorium*: Burton, M. (1937)

This sponge is found abundantly in the Madras Harbour, attached to the stonework from 4 to 6 feet below the low-tide mark. Thirty-two specimens were collected of which only five were found covering large living mussels as Annandale (1914) observed; the rest were in an irregular and shapeless mass attached to the stonework of the harbour. A large number of polychaetes, echinoids, copepods and isopods are associated with this sponge.

*Size*: Very thin film about 3 mm. in thickness.

*Colour*: Bright red in the living condition, becoming pinkish in spirit.

*Spicules*: *Tylostyles*: Smooth and sharply pointed; straight with oval heads. Axial tube is well develcped. Measure 0·245 mm. to 0·0054 mm. Head is 0·0081 mm. in diameter. Young and extreme forms are also met with, whose sizes vary from 0·15 mm. to 0·032 mm. respectively.

Microscleres: Sigmas: Found abundantly; some are C-shaped and some others S-shaped. Measure about 0·041 mm. by 0·0027 mm.

Anisochelae: Very small and scattered all over the body. Measure 0·0189 mm. from bend to bend.

### *Mycale madraspatana* ANNANDALE

*Mycale madraspatana*: Annandale, N. (1914)

*Mycale madraspatana*: Burton, M. (1937)

Three specimens were collected from the stonework of the boat-basin of the Madras Harbour. They were found 2 to 3 feet below the low-tide mark, attached to the shells of living as well as dead *Mytilus*.

*Size*: Thin films of about 2 mm. thickness.

*Colour*: Red when alive, becomes whitish on preservation.

*Spicules*: Tylostyles: Tapering with narrow, oval heads. Measure 0·276 mm. by 0·005 mm. The heads have a diameter of 0·007 mm.

Styles: Slender and of the same size as the tylostyles.

Microscleres: Anisochelae: Arranged in rosettes of different sizes. Measure 0·00473 mm.

Sigmas: Fewer than the anisochelae and measure 0·095 mm. Toxa are present in large numbers and are of two sizes, measuring 0·140 mm. to 0·356 mm. Larger toxa, although they are microscleres, are larger than the megascleres.

### *Mycale aegagsopila* var. *militaris* ANNANDALE

*Mycale aegagsopila* var *militaris*: Annandale, N. (1914)

Five specimens found encrusted on the dead as well as living molluscan shells were collected from the stonework of the Madras Harbour 3 to 4 feet below the low-tide mark.

*Size*: Very thin and fragile. Thickness is about 1 or 2 mm.

*Colour*: Bright scarlet while alive, which fades off into dull green when preserved in spirit. The scarlet colour is due to the presence of symbiotic algae.

*Spicules*: Tylostyles have well developed axial tubes, which extend to their prominent heads. Measure 0·257 mm. by 0·0054 mm.

Microscleres: Anisochelae are very small and measure 0·044 mm. by 0·0027 mm.

Sigmas measure 0·12 mm. by 0·0030 mm

Toxa measure 0·149 mm. by 0·0034 mm.

*Section Raspeliae*
*Genus Prostylissa*

*Prostylissa arcotti* sp. nov.*

*Diagnosis*: Massive, irregular and encrusting forms; colour in life, greenish; surface uneven, with conical projections and depressions; spongin is scarce; three types of oxea are present, viz., large, bent ones, long straight ones and slender ones, measuring about 0·612 mm. by 0·0135 mm., 0·5 mm. by 0·0135 mm., and 0·136 mm. by 0·0054 mm., respectively. Stout styli which are shorter than the oxea and measuring about 0·244 mm. by 0·011 mm., are also present.

*Occurrence*: This form occurs in large numbers along the Royapuram coast attached to rocks and other substrata, and is not found in the Madras Harbour.

*Description*: Twenty-five specimens were examined. These are encrusting and irregullar forms (Fig. 3) attached to the substratum by their broad bases. They are light greenish in colour in the living condition, and dirty greyish in spirit. They measure 250 mm. in length, 180 mm. in breadth and 80 to 100 mm. in thickness.

On the upper surface of the sponge, apart from the prominent projections, there are a few conical projections measuring about 10 to 20 mm. in height and 20 mm. in diameter at the broadest region. A few prominent oscula measuring about 1 mm. in diameter are strewn about on the upper surface of the sponge. More oscula are found on the projections than on the other parts of the sponge body. A large number of vents are scattered about, mostly on the upper surface of the sponge. A few, however, are also

*The author has great pleasure in naming this species after Sir Arcot Lakshmanaswami Mudaliar, the eminent gynaecologist and Vice-Chancellor, University of Madras.

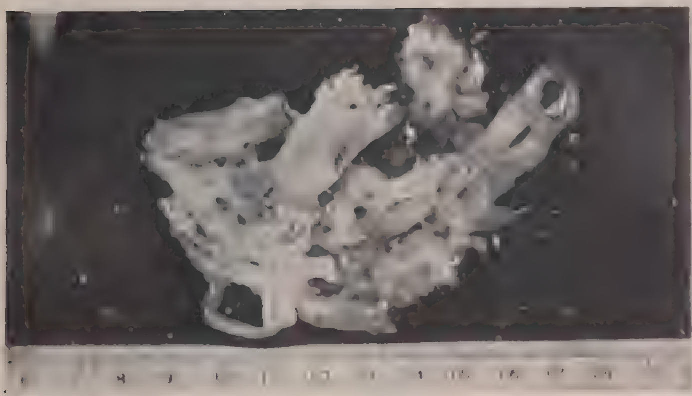


Fig. 1 Photograph of *Renieru delicatula* sp. nov.

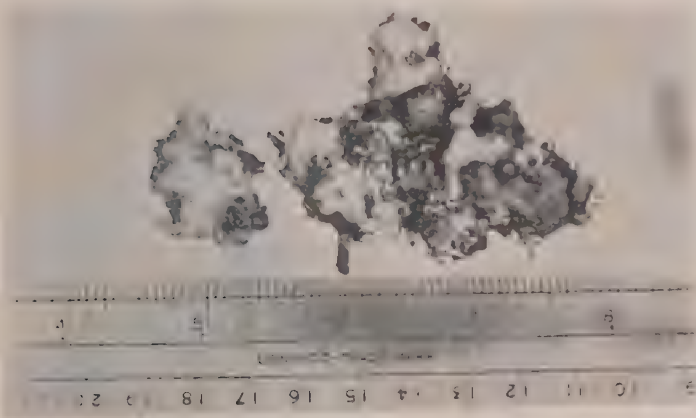


Fig. 2 Photograph of *Lissodendoryx similis* Thiele.

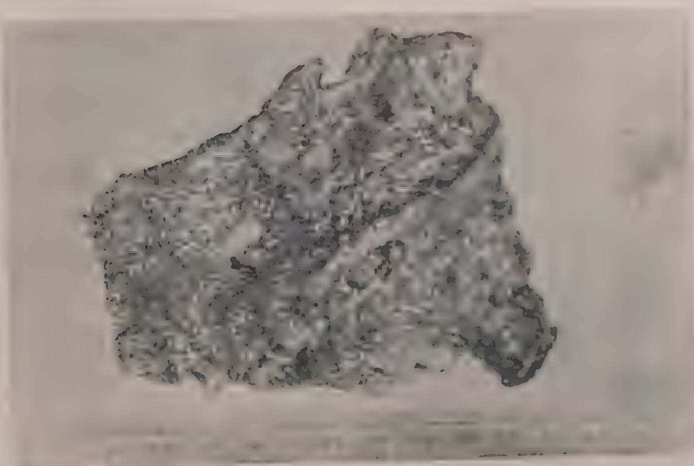
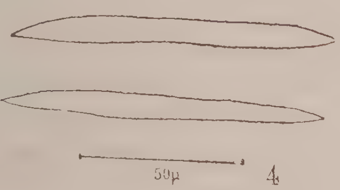
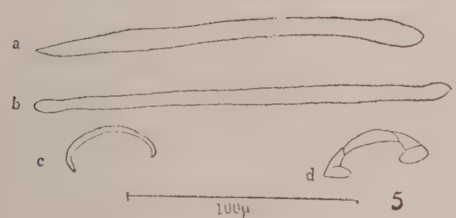


Fig. 3 Photograph of *Prostylissa arcotti* sp. nov.

present on the lower surface. In addition to these, the upper surface is covered with the margins of numerous vents. The lower surface, which is the base by which the sponge attaches itself to the substratum, is rough with long and prominent ridges and the face is uneven, in which molluscan as well as cirripede shells are embedded. In two or three sponges, algae, polyzoan and hydrozoan colonies as well as sea anemones, are found attached to the outer surface of the sponge. In all the rest the sponges were free from such associations.



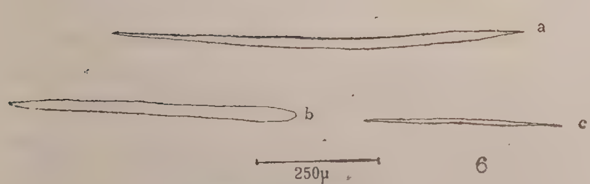




FIG. 4

Camera lucida drawings of spicules (oxea) of *Reniera delicatula* sp. nov.

FIG. 5

Camera lucida drawings of spicules of *Lissodendoryx similis* Thiele.
a:—Style; b:—Tylote; c;—Sigma; d:—Isochela.

FIG. 6

Camera lucida drawings of spicules of *Prostylissa arcotti* sp. nov,
a;—Oxea; b:—Style; c:—Smaller oxea.

*Skeleton*: Spongin is very scarce in this form and the multispicular fibres are found in an irregularly reticulate fashion. The oxea and the styli are seen to form a dermal skeleton.

*Spicules*: Two kinds of spicules (Fig. 6) are met with in this sponge, namely, oxea and styli. Microscleres are absent.

Oxea are of three types, viz., thick, bent ones which are bent in an angle of 135° at the middle, with tapering pointed ends; stout, long, straight oxea with tapering ends and small, straight, slender oxea. They measure 0·612 mm. to 0·285 mm. by 0·0135 mm. to 0·011 mm.; 0·501 mm. to 0·283 mm. by 0·0135 mm.; and 0·136 mm. by 0·0054 mm. The smaller oxea are possibly the young forms and are too large to be called Microxea or Onychata.

Styli are stout and are shorter than the oxea. They are present in large numbers, mainly forming the dermal tangential skeleton. These measure 0·244 mm. to 0·15 mm. by 0·01 mm. to 0·008 mm.

The reticulation of oxeas and the presence of a dermal-tangential skeleton composed of oxea and styli, undoubtedly place this form in the genus *Prostylissa*.

A number of specimens belonging to this genus have been described (Topsent, 1925, 1933; Burton, 1937; Rao, 1941; de Laubenfels, 1936). The species described from the Gulf of Manaar are *Prostylissa foetida* (Burton, 1937; Rao, 1941), and *Prostylissa oculata* and *Prostylissa heterostyla* (Burton, 1937). *Prostlissa foetida* differs from the other two by its massive, lobose nature and the presence of oxea which are slightly bent. *Prostylissa oculata,* on the other hand, has digitate processes with oscula on the summits, pseudexia and styli of two sizes. *Prostylissa heterostyla* differs from the above mentioned two species by the presence of inconspicuous oscula and the total absence of oxea.

The Royapuram sponge, whose description is given above, differs from the Gulf of Manaar specimens in the presence of an uneven surface, hardness in texture, greenish colour in the living condition and the presence of three types of oxea which are not found in the Gulf species. It resembles to a certain extent *Prostylissa foetida* in its massive nature and encrusting habit but the difference in spiculation, namely, the presence of large, slightly bent oxea, straight oxea and slender oxea distinctly separate this from *Prostylissa foetida,* which has only large bent oxea measuring 0·8 mm. In view of these distinctive features this is considered a new species and named *Prostlissa arcotti.*

*Summary*

(1) A general taxonomic survey of the sponge fauna in the Madras Harbour and Royapuram area has been carried out.

(2) Ten species of Monaxonid sponges, viz., *Pachychalina multiformis* Schmidt var. *manaarensis* Dendy; *Reniera delicatula* sp. nov.; *Oceanapia arenosa* Rao; *Callyspongia diffusa* Ridley; *Tedania nigrescens* Schmidt; *Lissodendoryx similis* Thiele; *Mycale mytilorium* Annandale; *M. madraspatana* Annandale; *M. aegagsopila* var. *militaris* Annandale and *Prostylissa arcotti* sp. nov., are described.

(3) *Reniera delicatula* and *Prostylissa arcotti* are species new to science. *Lissodendoryx similis* is recorded for the first time from Indian waters.



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# The Development of the Wood-boring Pelecypod *Bankia indica* Nair *

BY

N. BALAKRISHNAN NAIR, †
*Zoological Research Laboratory,*
*University of Madras*

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ABSTRACT

The development of *Bankia indica* is fully described from the moment of fertilisation to the metamorphosis of the veliger into the ship-worm. Notes and comments on the resemblances and differences noted between the Madras form and other forms which have been hitherto studied are given. The duration of the different larval stages, habits of the larvae as well as the prolongation of the free swimming period, if conditions are not favourable for settling are described.



*Part of a thesis which formed the basis of award of the Ph. D. Degree of the University of Madras.

† Present address—Department of Zoology, Alagappa College, Karaikudi.

I

*Introduction*

The classical work on the embryology of the Teredinidae is that of Hatschek (1880) who studied the early development of *Teredo* sp. After this the most important work in this direction is that of Sigerfoos (1896, 1908) who traced the early embryology of *Bankia gouldia* and *Teredo dilatata* at Beaufort. This author further studied the metamorphosis of the settled veliger into the young ship-worm. Sigerfoos, (1908) however, was unable to rear the larvae in the aquaria. He states: "The mode of life of the larvae and the rate of development beyond the early stage attained so rapidly in the aquaria have not been determined. What becomes of the larvae after hatching from the eggs, how and where they live, it is difficult to surmise" (P. 196). Descriptions of the larvae of the ship-worms have been given from time to time by many workers such as Miyazaki (1936), Lebour (1938), Thorson (1946), Sullivan (1948), and Rees (1950). Edmondson (1942) presented brief accounts of development of two species namely *Teredo bartschi* and *Teredo mediolobata* occurring in the Hawaiian waters. Subsequent to the publication of the development of *B. gouldi* by Sigerfoos forty seven years ago, no significant contribution seems to have been made to a study of the development of the Teredinidae. Since a knowledge of the development of these borers is necessary for the control of these pests and since nothing is known regarding the life history of any tropical oviparous form, a study of the development of the common Madras form *B. indica* was attempted.

II

*Material and Methods*

Genital products obtained from ripe males and females several times each year were used for artificial fertilisation. Fertilised eggs were also obtained when once in July 1954 males and females in the same container happened to spawn simultaneously. The free swimming early veligers obtained in each case were reared further in small glass tubes of 1″ diameter whose two ends were tied with muslin cloth, and the cylinders suspended in the sea. There was less mortality in these than in the laboratory aquaria and finger bowls and stages represented in figures 10 and 11 were drawn from material obtained in this way. In three instances the larvae were found attached to the small pieces of wood provided in the tubes

about 17th to the 20th day after fertilisation to facilitate metamorphosis.

Free swimming larvae of different stages were also secured from two hundred and fifty samples of townet plankton collected in the inshore waters of Madras during the period of 1954-1955. These also were reared in the laboratory containers to settling stages. By carefully rearing the larvae of younger stages to older ones it has been possible to cover the gaps between the stages obtained and to get a connected, continuous picture of the development from fertilised egg to the settling veliger. The settling of the veligers was easily noticed in the laboratory, when late veligers were provided with pieces of wood in finger bowls. Further, settling veligers were obtained in large numbers during the height of the breeding season by suspending small wooden panels in the sea. By transferring the entire panels to large troughs of sea water the metamorphosis of the veligers which had settled on the panels was observed. Additions of small quantities of vital stains like neutral red and frequent changing of the sea water with a pipette whose nozzle had been plugged with cotton helped to minimise the attack of ciliate parasites in the culture bowls during the early stages of development.

Weak solutions of lactic acid, osmic acid and cocaine were found useful in narcotising, and Bouins fluid as well as 3% formalin for fixing the different stages of the larvae. Borax Carmine and Meyer's Haemalum were used for staining. The drawings were made from live material with the aid of a *camera lucida.*

## III

### *The Germ Cells*

The *ripe ovum* (Fig. 1) is spherical with an average diameter of 45μ. It is surrounded by a thin, almost transparent vitelline membrane which is visible when the egg is stained with borax carmine. Traces of finely divided globules of deutoplasm of a light yellowish hue are distributed almost uniformly throughout the cytoplasm. The germinal vesicle is large and almost centrally situated, having a diameter of 25μ with a nucleolus which is clearly distinguishable.

*The sperm*: The sperms are very small having a length of from 9 to 12μ consisting of an almost circular head which stains deeply and a protoplasmic flagellum.

*Fertilisation*: Ripe males and females were washed in filtered sea water and slit open and the active sperms and ripe eggs were removed to separate watch glasses by using sterilised pipettes. Artificial fertilisation was carried out in filtered sea water by mixing the sperms and eggs. Since fertilisation takes place immediately, development was timed from this moment. Excess of sperms was removed by pipetting out the seawater from the top and fresh filtered sea water was added. The first polar body was extruded from the egg after five minutes, while the second polar body was nipped off twelve minutes after fertilisation. The two polar bodies are transparent and more or less of the same size. Their position marks the animal pole in an otherwise almost alecithal, isotopic egg. About eight minutes after the second polar body was budded off, several changes were noticed in the egg. The cytoplasm become less opaque and the nucleus moves from the centre towards the animal pole and becomes visible towards the periphery.

## IV

### *The Early Development*

a. *Cleavage stages*: About 50 minutes after fertilisation the first cleavage begins as a constriction slightly above the equatorial plane. This constriction deepens and divides the egg into two unequal portions (AB, CD, Fig. 2) of 15μ and 32μ in diameter. Very soon the two blastomeres, press against each other and flatten at the point of contact. As a result the smaller blastomere AB forms a cap for the larger CD. The smaller cell is clearer than the larger cell. This difference, according to Lillie (1895) is because of the greater transparency due to lesser mass than to differentiation of cell substances. The first cleavage is total and completed within an hour after fertilisation.

Within thirty minutes after completion of the first, the second cleavage, a meridional one, divides the small blastomere into two approximately equal halves. When this division is in progress the nucleus of the larger cell CD moves towards the right side and effects a cleavage into two unequal cells, the smaller one C measuring 15μ and the larger one D occupying the posterior region. The divisions of the blastomeres AB, and CD taken together represent the second division of the fertilised egg. (Fig. 3).

Within two hours after fertilisation the third cleavage takes place. The blastomere D buds off another small cell $d_1$ and this is

followed by the division in succession of C, A and B in a similar manner and thus the embryo reaches the eight-cell stage (Fig. 4). The four-daughter cells $a_1$, $b_1$, $c_1$, and $d_1$, which are nipped off towards the upper pole represent the first generation of ectomeres. They are 13μ in diameter each and smaller than the cells from which they have been obliquely cut off. This first generation of ectomeres even while they are formed are slightly rotated in the clockwise direction. Thus each micromere is found just to the right of the macromere from which it took its origin. The four micromeres lie upon and alternate with the four macromeres.

The first cell of the second generation of ectomeres is formed through the unequal division of the macromere D. This division is peculiar in that the cell budded off ($d^2$) is larger than D. This is followed by the division of the parent macromeres C, A and B giving rise to $c^2$, $a^2$ and $b^2$. Thus the second quartette of ectomeres is formed. The cells of this second generation with the exception of $d^2$ are about the same size being about 20μ in diameter. The embryo is in the twelve celled stage (Fig. 5). As a result of the division of the first generation of ectomeres, $d_1$, $c_1$, $a_1$ and $b_1$ a third generation of ectomeres is formed which contributed to the upper tiers of cells and thereafter the sequence of cell divisions was difficult to follow. Five hours after fertilisation the embryo assumes a mosaic shape as shown in Fig. 6 and measures 65μ.

Of the six times when the cleavage was studied, during four, the divisions were unequal as recorded above, while in two instances the blastomeres were equal in size, there being no distinction between the parent and the bud. It is possible that unequal divisions are the rule and equal divisions are exceptions.

b. *The gastrulation process.* The cell divisions progress rapidly. The ectoderm is derived from the four parent cells, A, B, C and D by three successive cleavages. These lie on the parent macromeres which are orientated towards the posterior end of the embryo as seen in Fig. 6. The endoderm is formed from there four macromeres while the mesoderm is derived from the macromere D after it has given rise to the ectoderm, in the form of two distinct, large cells and lie symmetrically on either side of the median plane at the posterior end. Due to the multiplication of the micromeres the ectodermal cells overgrow and surround these mesoderm cells and endoderm cells and tuck them in into the interior of the embryo. Thus epibolic gastrulation takes place within six hours after fertilisation and the archenteron is derived through the multiplica-

tion of the four endoderm cells which communicate with the exterior through a circular blastopore lying at the posterior end of the oval gastrula. The embryo after gastrulation measures 70μ.

When the gastrula is two hours old (i.e., eight hours after fertilisation) a solid mass of endoderm cells and two large and a few small deeply staining mesoderm cells can be seen inside the embryo in stained preparations. The endoderm cells multiply rapidly to give rise to the embryonic enteron. The blastopore at this stage is reduced to a small slit by the multiplication and growth of the cells of the blastopore lips. In the meanwhile the ectodermal cells multiply more rapidly than those of the endoderm so that the two layers become separated and the primary body cavity is formed. The stomodaeum makes its appearance as an invagination of the ectoderm 12μ deep in the region where the blastopore has closed. Three hours later the proctodaeum is formed as an inpushing of the ectoderm at the extreme posterior end. This invagination abuts into the endodermal mass in between the mesodermal cells. At about this time the cells lying on the dorsal region of the embryo become well-defined and squarish and form a plate. This invaginates and (Fig. 7 SHG) in the cavity is secreted a very delicate and transparent shell. As the embryo grows, this shell gland spreads out and the shell material deposited assumes the form of a cap covering the whole gland area. No hinge is perceivable at this stage. During the process of deposition and formation of the larval shell the epithelial cells forming the gland become so thin that their nuclei appear protuberant. At this stage the embryo is elliptical in shape 75μ in length and 52μ broad. The minute cilia covering its surface begin to beat and rotate the embryo within the membrane which soon breaks and the larva is hatched. Thus the free swimming stage is reached 11 hours after fertilisation. Sigerfoos (1908) found that *Bankia gouldi* hatches within three hours.

## V

### *The Larva*

a. *The trochophore*: Thirteen hours after fertilisation i.e., about two hours after hatching the egg shaped larva becomes slightly broader at its anterior end with the result it assumes the shape of a top (Fig. 8). In addition to the feeble cilia developed all over the surface, strong conspicuous cilia are developed along two distinct bands. A conspicuous preoral band of cilia, the prototroch is developed in front of the stomodaeal invagination com-

posed of a double row of ciliated cells. A post oral band, parallel to the preoral belt composed of a single row of less conspicuous ciliated cells is developed behind the stomodaeum. A third group of long cilia is formed near the proctodaeal invagination. At this stage the essential function of the ciliated bands is to propel the trochophore. The trochophore measures 80μ in length and 57μ broad at the region of the prototroch. The stomodaeal and proctodaeal invaginations abut on the endodermal part of the digestive tract but do not communicate with the lumen formed within the endodermal cell mass which elongates owing to rapid cell multiplication.

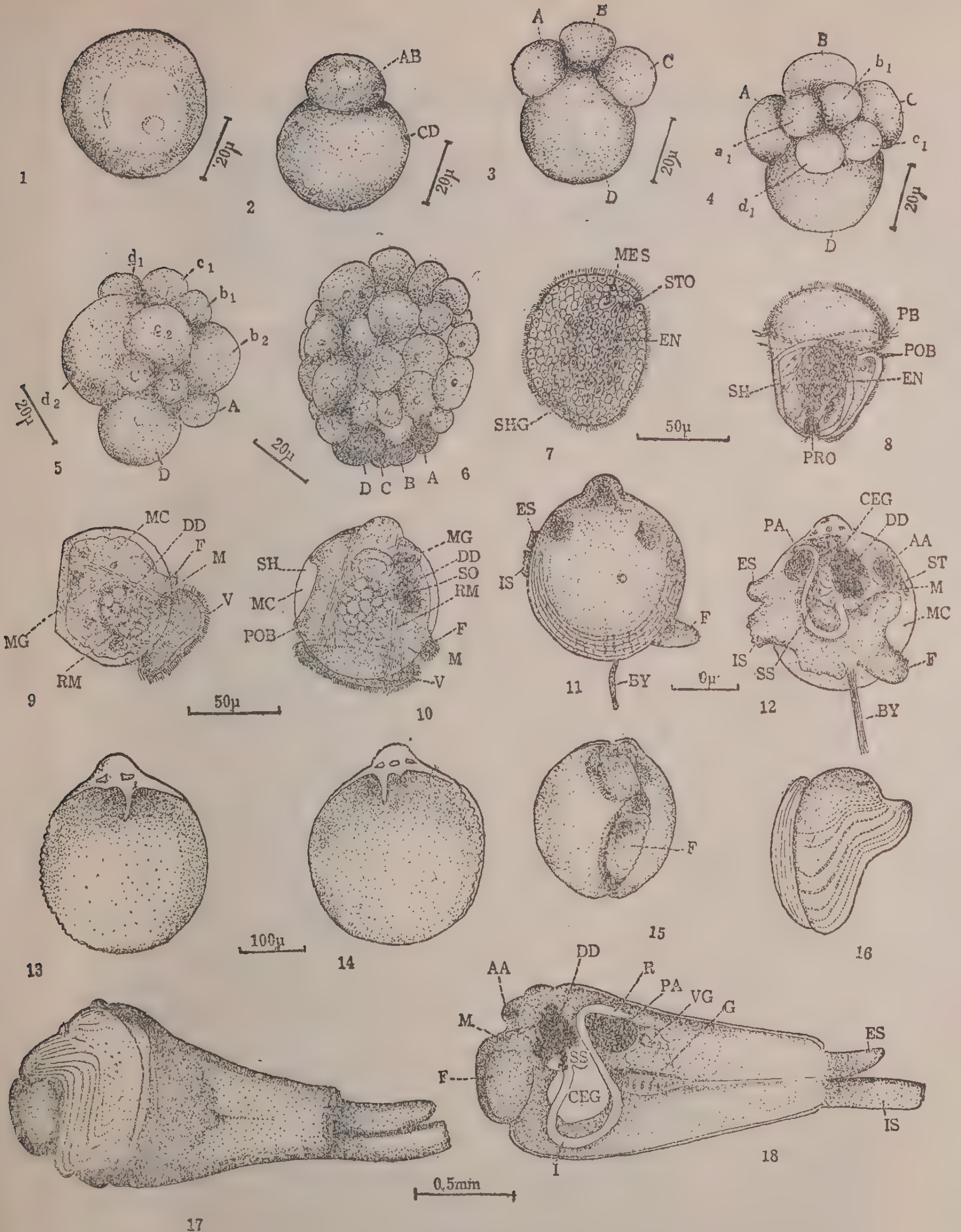
This trochophore larva swims about for nearly eight hours during the course of which by the activity of the shell gland a characteristic shell is deposited.

b. *The transformation of the trochophore larva into the early veliger:* Within twenty one hours after fertilisation i.e., when the trochophore larva is eight hours old it becomes the early veliger. A pronounced development of the strong biserial band of preoral cilia takes place with the result that the anterior region of the larva shows a general enlargement. This area with its crown of motile cilia projects beyond the larval shell for a distance of about 12μ to become the velum, the most conspicuous part of the larval body. The shell at this stage has a straight side and is therefore D shaped. (Fig. 9). The larva is usually referred to as the 'D' shaped larva or as being in the straight hinge stage, even though it has no hinge. It measures 75μ in length and 60μ across. The velum is equipped with a set of retractor muscles which can retract it into the "prodissoconch" (Werner 1939). A broad median protuberance is developed ventral to the stomodaeum which is the rudiment of the foot. The stomodaeal invagination communicates with the endodermal tube which is slightly saccular and forms the rudiment of the stomach. Immediately below this the intestine which is a narrow prolongation of the stomach joins the proctodaeum near the base of the foot. Above the level of the intestine i.e., between the outer ectoderm and the endoderm of the gut is visible a group of vacuolated cells which is probably the rudiment of the larval kidney. On either side of the base of the foot below the level of the ectoderm the otocysts are formed as ectodermal invaginations consisting of a small vesicle containing refractile granules.

c. *The early veliger:* On the third day of development, i.e., about 72 hours after fertilisation, the D shaped larva shows a

much better developed velum with thickened edges bearing stronger and longer cilia. The stomadaeum has elongated and the Oesophagus is demarcated as a tube 12μ long which joins the saccular stomach near the region where the latter communicates with the lateral rudiments of the digestive diverticula. The intestine has become longer, convoluted and slender. A minute projection of the posterior wall of the stomach marks the crystalline style sac. The shell gland appears thinner and spreads to a larger extent as a consequence of which the shell grows in size. The foot, which was only a mere median protuberance beneath the stomodaeal region, has now become longer, broader and slightly mobile. The cells composing the digestive diverticula became pigmented. The mantle is developed on either side as lateral outgrowths of the ectoderm. The secretory activity of this layer contributes to the further growth of the larvel shell both in size and thickness. The shell grows in this way sufficiently to cover the whole body. The duration of this early veliger is about six days during the course of which it grows from $75 \times 60\mu$ to $90 \times 70\mu$ in size. During the course of the fourth day, the prismatic shell layer is formed round the margins of the valves making this region distinct from the earlier prodissoconch. This growth proceeds with the result that on the eleventh day the larval shell assumes a bulbous form with the convex valves. By about fifteen days the larva increases to $250\mu \times 265\mu$ in size. The shell height at this stage is distinctly more than shell length, marked by well spaced lines of growth especially towards the ventral margin where radial rays are also distinguishable.

d. *Structure of the late veliger* (Figs. 11, 12). On the fifteenth day after fertilization, the larva is a typical lamellibranch veliger with an almost translucent shell having a light brownish flush, the valves of the shell at this stage are equilateral, characteristically convex with high, steeply slanting, narrow shoulders, prominent knob-like umbones and short sharply curved bases. The larva at this stage measures 265μ high and 250μ long. In the shell the prodissoconch I is marked off from the prodissoconch II. The straight portion of the margin of the valves where they are in contact when the valves gape is slightly thickened forming a provinculum (Bernard, 1898) bearing the provincular teeth, the right valve bearing three and the left one two (Figs. 13, 14). The hinge ligment of the shell is placed posteriorly above the provincular teeth. The apophysis is seen as a tooth-like projection springing from the umbonal side.




Figs. 1-18

1. Surface view of the ripe ovum. 2. Two-cell stage. 3. Three-cell stage. 4. Eight-cell stage. 5. Twelve-cell stage. 6. Early stage in gastrulation. 7. Eleven hour old larva after hatching. 8. The trochophore larva. 9. The early veliger. The "D"-shaped larva. 10. The veliger larva on the 11th day. 11. The late veliger on the 15th day. 12. The veliger larva on the 15th day with the valve and the mantle removed to show the internal organisation. 13-14. Right and left shell-valves of the attached larva with one row of denticles. 15. The settled larva removed from the wood on the 17th day (not drawn to scale). 16. The shell of the 2 mm. long ship-worm. 17. The young ship-worm, 2 mm. long. 18. Two mm. long ship-worm with the mantle and shell removed from the left side.

The velum, which is situated antero ventrally, has not only increased in size, but has its edges thickened and fringed by cilia 7μ long. These cilia help the larva to swim about rapidly and to capture food. A ceaseless downward displacement of water is maintained by the velar cilia drawing the water towards the mouth situated between the velum and post-oral belt of cilia, This downward flow of water conveys the food particles to the mouth. From here the food is taken into the oesophagus by the strong inward current created by the action of the oesophageal cilia. The food particles can be seen swirling in as a result of the ciliary currents.

The velum is retractile into a large velar cavity situated at the anterior ventral part of the shell cavity. The dorsal retractor muscle by whose contraction the velum is withdrawn into the cavity of the shell arise posteriorly from the left side of the larva behind the large liver lobes and run forwards. Opposite the middle region of the stomach it divides into two strands which thence pass anteriorly and terminate in the velum at the antero-ventral region. Beneath the velum is the long flexible cylindrical foot which when fully extended measures 75μ. The upper surface of the foot alone is ciliated and the lower side is glandular helping the larva to crawl about over the substratum. In these respects, the present form differs from *B. gouldi* whose foot is angular at its posterior end and is ciliated on the upper and lower surfaces (Sigerfoos, 1908). At the posterior end of the foot is a long transparent byssus thread. The foot can be completely withdrawn by the right and left retractor muscles of the foot which arise at the dorsal middle part of the umbo in front of the posterior adductor of the larva and along the sides pass anteriorly to terminate in the foot.

The mouth at this stage is a wide funnel-shaped orifice situated between the velum and the foot and it leads into the thick-walled, ciliated oesophageal tube. The liver lobes of the stomach have grown considerably on either side of the latter and become darkly pigmented. The intestine is seen to start from the middle region of the stomach where the oesophagus ends and the style sac begins. The intestine forms a U shaped loop and ascending between the posterior adductor and the stomach (Fig. 12) bends round the former to run back as the rectum to open at the anus on the dorsal side of the mantle cavity near the base of the exhalent siphon. The style sac is a small pouch formed from an evagination of the posterior part of the stomach wall and is formed of

granular ciliated cells. The caecal rudiment is hemispherical and is seen on the right side as an outpushing of the stomach about 40μ long posterior to the origin of the intestine. The stomach is lined with short cilia.

At the posterior end of the larva the two siphons are developed from the mantle and project backwards from the visceral mass, the inhalent being slightly longer than the exhalent. The adductor muscles are well developed, the anterior is situated above the opening of the mouth and the larger posterior, below the anal orifice. The renal rudiments can be made out at this stage as a mass of vacuolated cells extending backwards to the external opening in front of the posterior adductor.

This larva leads a pelagic life swimming about actively and feeding on the plankton. It is probable that these larvae have considerable powers of endurance since they survived in the laboratory even when the sea water in the culture bowls were not changed for nine days. The larvae when they are seventeen days old are ready for settling on wood. Preparatory to this they crawl on the surface of the pieces of wood left in the container for about an hour. During this period their activity gradually diminishes till they fix their foot into a depression on the surface of the wood. Later they lift the shell up about this point to which the byssus thread was attached in the meanwhile. Once the larva settled thus the velum, which served as the mobile organ so far, appeared retracted. It was further noticed that rough surfaces of the panel received more larvae than polished ones. Larve which were not seventeen days old also sometimes swarm towards and rested on small wood pieces in the culture bowls. They crawled on the surface of the wood actively for sometime and then extended the velum and swam off. Sometimes the larvae remained motionless at the surface of the water adhering to the surface film. Disturbances of water such as stirring the surface resulted in the larvae withdrawing the velum into the shell for as long a period of 20 to 30 minutes and sinking down passively to the bottom. After lying flat on one valve for sometime, the larvae everted the foot and crawled about the bottom for a short time. Later thrusting out the velum they swam up towards the surface in a characteristic spiral manner. If no wood pieces were offered for settlement, the larvae swam about for even upto 26 days. In such larvae the siphons grew and projected beyond the shell and two to four rows of denticulated ridges were developed on the anterior shell

border suggesting a precocious preparation for settlement while still retaining the larval characters. It may therefore be inferred that the normal period of free swimming life is 17 days. Such a prolongation of the free-swimming period has been noted in other forms like echinoderms, polychaetes and some other lamellibranchs (See Thorson, 1946).

No exact information is available regarding the duration of free swimming period in the non-incubatory species of teredines, though Sigerfoos (1908) suggests that veligers of *B. gouldi* swim about for a month at Beaufort. *Teredo navalis* has a maximum free swimming period of about three weeks (Grave, 1928) at Woods Hole, and for about 35 days (Imai Takeo *et al.*, 1952) in the Japanese waters.

It is noteworthy that *Bankia* is able to retain its larval organs and postpone metamorphosis into the adult animal if a suitable substratum is not available, and to continue as a free swimming larva for a period of even nine days after attaining the stage when it can settle and metamorphose. The capacity to prolong the free swimming period, is of survival value since it helps the larvae to cover a wide area in their search for their appropriate substratum and since it increases the chances of their encountering a piece of wood, on which they can settle and perpetuate the species.

## VI

### *The Attachment of the Larvae*

The attaching veligers measured 273μ high and 265μ long on an average. Sigerfoos (1908) states that the byssus thread is formed just before the loss of the velum after setting on wood. This is not the case with the Madras form, the byssus being already present in the late veliger and used as an anchor during the settlement. The long mobile foot seems to be used in the selection of a suitable spot. When the spot has been 'selected' the distal extremity of the foot adheres to the wood. Now the larva raises its body on the foot and describes an arc of 90° with the substratum. This rotation of the larvae followed by the contraction of the foot brings the anterior margin of the larval shell into contact with the wood. About 18 days after fertilisation, i.e., 20 hours after attachment the first row of denticles is fully developed and about 60 hours after settlement the shell shows three rows of denticles on the anterior border of the shell. In a few instances two or

four rows were observed. At this stage the movements of the larvae were difficult to observe as they were covered with agglutinated particulate matter.

## VII

### *Metamorphosis of the settled veliger into young shipworm*

Metamorphosis of the larva starts with the atrophy of the larval swimming organ, the velum. Sigerfoos (1908) states that the velum in *B. gouldi* is cast off and eaten by the larva. However, the author has not been able to observe this in *B. indica*. The *shell* shows, ninety hours after attachment, seven rows of denticulated ridges, sculpturing its surface. Further, the ventral margin grows more rapidly than the rest of the shell and curves inwards so that the middle region of the shell enlarges as the most prominent part and appears bent on the anterior margin forming an angle (Fig. 16). The position of the anterior lobe is indicated by the horizontally disposed dental ridges. A wing-like outgrowth appears on the posterior margin of the median portion on the inner surface of which the posterior adductor muscle is inserted. The two valves become articulated to each other through the development of two knobs on each valve, one on the umbonal region and a slightly smaller knob at the ventral edge. Owing to the articulation of the valves through these knobs the valves gape in front and behind. A long blade, the apophysis, is formed from the umbo of each valve. This provides attachment for the retractor muscles of the foot which were attached to the umbonal region before. The long cylindrical *foot* becomes shorter and knob-like with a central sole and ciliated edge as in the adult. The fusion of the mantle lobe which starts when the larva is about 72 hours is completed by the time it reaches 5 days after settlement, leaving the anterior pedal opening and the two posterior siphonal apertures. Dissection of a juvenile ship-worm 2 mm. long (Fig. 18) shows that the *alimentary canal* has undergone important modifications. The caecum has become a large saccular evagination of the stomach wall 250μ long and can be seen between the U shaped loops of the intestine below the rudiment of the crystalline style. The sac of the crystalline style has grown further and measures 120μ and is placed at a level below the posterior adductor. The oesophagus is a short tube 90μ long and is dorsoventrally compressed. The stomach extends posteriorly due to the elongation of the animal and extends as far as the posterior adductor muscle.

Five days after attachment many of the young shipworms had bored into the wood to a depth of about 1·6 mm. A few took more than seven days to reach this stage. The shell has by this time assumed the general form of the adult, differing only in details. It measures 0·9 mm. in height and 0·8 mm. in length and has a remnant of the larval shell at the dorsal border. Nine rows of denticles are seen at the anterior portion and four distinct rows on the anterior median part of the shell. The anterior lobe is distinctly marked from the rest of the shell while a thin posterior lobe 100μ wide extends along the entire posterior border.

The gill rudiments are present as ectodermal folds covered with cilia on each side of the body of the settled veliger. They develop from behind forwards as a simple plate in the beginning. After settling the differentiation of the gill filaments take place from before backwards by the appearance of perforations in succession. As growth proceeds these perforations become long and slit-like dividing the gill plate into filaments. In a 2 mm. long ship-worm the gill extends to about 350μ behind the visceral mass.

During the metamorphosis of the larva into the adult shipworm the pericardial cavity with the contained heart undergoes a change in its relation to the intestine. The growth and elongation of the visceral mass first ventrally and then posteriorly results in a twist of the intestine so that the pericardium appears on its upper side and extends from the posterior adductor to the tip of the visceral mass. In the 5-day old larva the heart consists of two halves with a spherical auricle on each side leading to the ventricle of that side. In the subsequent development the right and left halves of the ventricle undergo fusion in the mid-line.

Thus, the metamorphosis into the adult is not a sudden process as has been reported for *B. gouldi* (Sigerfoos, 1908) but a gradual attainment of adult characters through the modification of the larval organs.

*Chronological Order of Events in the Development of Bankia indica*

| | | |
|---|---|---|
| First polar body | .. | 5 minutes after mixing eggs and sperms. |
| Second polar body | .. | 12 " " " |
| First segmentation division completed | .. | 60 " " " |
| Second segmentation division | .. | 90 " " " |
| Third segmentation division | .. | 2 Hours " " |
| Gastrulation is completed | .. | 6 " " " |
| Shell gland is formed | .. | 11 " " " |
| Larva is hatched | .. | 11 " " " |
| Trochophore is formed | .. | 13 " " " |
| Early veliger is formed | .. | 21 " " " |
| Characteristic veliger stage reached | .. | 11 days " " |
| Attachment of the larva | .. | 17 " " " |

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*Key to the lettering of figures.*

| | |
|---|---|
| AA | — anterior adductor |
| BY | — byssus thread |
| CEG | — caecum of the stomach |
| DD | — digestive diverticula |
| EN | — endodermal cells |
| ES | — exhalant siphon |
| F | — inhalant siphon |
| G | — foot |
| IS | — gill |
| M | — mouth |
| MC | — mantle cavity |
| MES | — mesodermal cells |
| MG | — midgut |
| PA | — posterior adductor |
| PB | — pre oral band of cilia |
| POB | — post oral band of cilia |
| PRO | — proctodaeal invagination |
| R | — rectum |
| RM | — retractor muscle |
| SH | — shell |
| SHG | — shell-gland rudiment |
| SO | — sense organ |
| SS | — style sac |
| St | — stomach |
| STO | — stomodaeal invagination |
| V | — velum |
| VG | — visceral ganglion |

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# The Food of Two Grey Mullets of the Madras Coast

BY

M. D. K. Kuthalingam

*University Zoology Laboratory, University of Madras*

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ABSTRACT

Analyses of the food taken from 710 fishes belonging to the two commonest species of Grey mullets are presented. The diets of 138 Juveniles belonging to the two species are compared with those of the adults and discussed.

The adults of this two mullets feed on Foraminifera, Polychaetes, sand, decayed organic matter etc., occurring in the sea bottom, while the juveniles feed on algae, copepods and larval forms occurring in the surface plankton.

*Introduction:*—The importance of the studies on the food of fishes in fishery biological investigations is well-known and considerable attention is being paid at the moment to this problem in India. However several of the papers published are based on examinations of small numbers of specimens collected at random. To obtain a correct picture of the food and feeding habits of a fish a comparative study of all available age—groups covering all the seasons and environments of its occurrence is essential.

Regarding the food and feeding habits of Grey Mullets diverse views have been expressed by the following authors. Bapat and Bal (1952) while studying the food of *Mugil parsia* in Bombay waters came to the conclusion that the main food of this species was copepod, diatoms as well as organic matter taken along with mud. Chidambaram and Kuriyan (1952) concluded that *Mugil troschelli, Mugil waigiensis,* and *Mugil seheli* of the Gulf of Mannar are primarily plankton feeders but occasionally browse along the bottom. Sarojini (1954) found that the food of both *Mugil parsia* and *Mugil speigleri* was basically the same consisting of decayed organic matter from the bottom, as well as algae and diatoms from the benthic zones. Pillay (1953) found the adults of *Mugil tade* feeding on decayed organic matter from the sea bottom. These diverse observations indicated the need for examining

a little more closely the food and feeding habits of Grey mullets and hence the present study was made on the two species available throughout the year at Madras.

*Mugil dussumieri*:—This grey mullet is called "Madavai" in Tamil and is distributed in seas of India as far as Malay Archipelago and beyond and they are occasionally caught in rivers. Out of 312 fishes examined 56 had no food in the stomach. Of the 209 females 90 were mature and out of 103 males 60 were immature. Different size groups ranging from 3 cm. up to 20 cm. were collected. It is of interest to note that the immature fishes feed more than the mature ones. The following table will illustrate this statement.

TABLE I

Table showing the condition of feed and also the length of the fishes examined during mature and immature states.

| Degree of feed | Length of fishes. 6cm. to 10cm. | | 11cm. to 15cm. | | 16cm. to 20cm. | |
|---|---|---|---|---|---|---|
| | mature | immature | mature | immature | mature | immature |
| Empty .. | 16 | 7 | 15 | 3 | 11 | 4 |
| Little .. | 20 | 4 | 16 | — | 21 | — |
| ¼ full .. | 14 | 4 | 18 | 4 | 10 | 3 |
| ½ full .. | 8 | 4 | 2 | 9 | 6 | .. 7 |
| ¾ full .. | — | 14 | 6 | 21 | 3 | 11 |
| Full .. | 2 | 12 | 4 | 19 | 2 | 12 |

From the analyses of the stomach contents it was evident that bottom foraminifera and organic debris in foraminiferan sand form the main item of food of this species. They were identified as *Noneonella, Elphidium, Rotalia pulchella, Peneroplaidae, Biloculine* and *Triloculine*. Apart from this there were other unidentifiable forminiferan shells. Gnanamuthu (1943) recorded that forminiferan shells from the stomach of mullets which indicate that they feed on the bottom of littoral areas. Molluscan food item was represented by bivalves and gastropods. There were also broken shell pieces of bivalves. Polychaetes formed a regular item of diet. Polychaetes belonging to the family *Maldanidae, Glyceridae,*

*Polynoidae* and *Typhlendecidae* were identified. Numerous tubes of the tube-dwelling polycheates, parapodia, isolated segments and setae of Polychaetes were present. On one or two occasions Nerids also were found. Since Polychaetes belonging to these families are bottom forms it may be concluded that this Grey mullet is a bottom feeder. Crustacea formed a small fraction of the food and were mostly copepods such as *Oithona rigida, Oithona linearis, Corycella gibbula, Paracalanus parvus, Aeartia erythraea, Schmackeria serricaudatus, Centrapages sp., Tortanus sp* and *Euterpina acutifrons.* Since these copepods are usually surface forms, it is likely that this bottom feeding fish occasionally swims up to the surface. Algae also were found in the stomach in the month of June, July, August, December and February. Species of *Oscillatoria* and *Enteromorpha* were the only green algae that could be identified. An average of 0·5% of the total volume of food was of green matter. The data are presented in Table 2.

*Juveniles:*—A total number of 72 juveniles of *Mugil dussumerei* ranging from 3 cms. to 4·5 cms in length were collected in the months of February, November, and January from the fisherman's net. Copepods, *Acetes, Lucifer, Mysis* and *Squilla* larvae formed the major item of diet. *Sagitta* was very rarely met with in the stomach. Teleostean food item was very negligible. They were represented by fish eggs and post larval forms. It will be seen that while the adults feed on foraminifera, polychaetes, molluscs and bottom forms mainly, the juveniles prefer the smaller crustacea living near the surface, obviously because the juveniles live close to the surface. Pie diagram A and B show the difference of diet between juveniles and adults.

Both juveniles and adults appear to use the Madras inshore area for feeding purposes. Since no eggs of the fish are found in the area it is probable that the mature adults migrate away from Madras waters for spawning.

*Mugil caeruleo-maculatus*: — Distributed from Mauritius and Bombay through the seas of India to Malay Archipelago and beyond. There has been no previous work on the food and feeding habit of this species. Of the 408 fishes examined except 69 all had food in the stomach. Both sexes were equally represened. The analyses of the stomach contents showed no difference between males and females as also between mature and immature fishes.

TABLE II

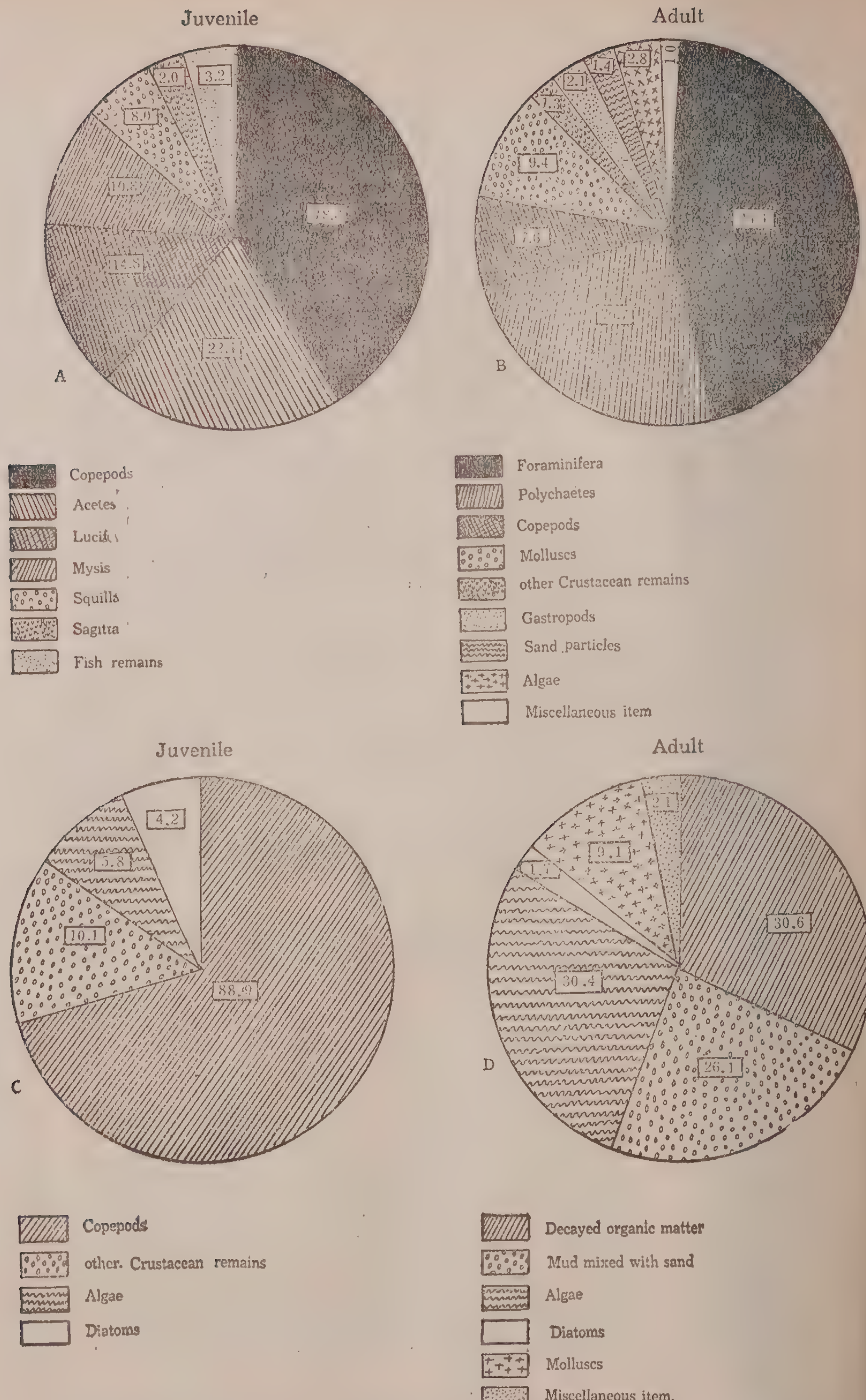
Table showing the total average volume of food and also the percentage average of the various food items of *Mugil dussumieri*.

| Particulars | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | March | April |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol. of stomach contents in ml. .. | 0·3 | 0·2 | 0·4 | 0·3 | 0·5 | 0·6 | 0·4 | 0·3 | 0·4 | 0·3 | 0·4 |
| Foraminifera .. | 45·0 | 47·2 | 28·2 | 32·6 | 55·8 | 49·8 | 58·2 | 35·8 | 42·8 | 48·3 | 41·7 |
| Polychaetes .. | 22·0 | 25·5 | 30·6 | 24·8 | 29·4 | 19·0 | 16·3 | 46·4 | 26·0 | 21·3 | 32·8 |
| Copepods .. | — | — | 9·2 | 18·4 | — | — | 12·6 | — | 12·2 | 19·3 | 12·3 |
| Other crustacean remains .. | — | — | — | 4·4 | — | 8·7 | 8·2 | 9·0 | 3·8 | 2·4 | — |
| Molluscs .. | 10·2 | 12·2 | 11·7 | 17·8 | 12·7 | 21·4 | — | 4·8 | 7·2 | 6·0 | — |
| Gastropods .. | 2·8 | 1·2 | — | — | — | — | 2·0 | — | 4·0 | — | 5·0 |
| Sand particles .. | 1·8 | 3·6 | 2·2 | 2·0 | 2·1 | 1·1 | 1·3 | 2·5 | 1·2 | 2·7 | 2·0 |
| Diatoms .. | 6·2 | — | 8·3 | — | — | — | — | 1·2 | — | — | — |
| Algae .. | 8·8 | 9·7 | 9·8 | — | — | — | 1·4 | — | 1·8 | — | — |
| Miscellaneous green matter .. | 30· | 0·6 | — | — | — | — | — | 0·3 | 1·0 | — | 6·2 |

TABLE III

Table showing the monthly average total volume of food and also the percentage average of the various food items of *Mugil co-eruleo-maculutus*

| Particulars. | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | March | April |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume of stomach content in ml. .. | 0·4 | 0·2 | 0·5 | 0·3 | 0·3 | 0·6 | 0·4 | 0·6 | 0·5 | 0·5 |
| Decayed organic matter .. | 43·8 | 18·2 | 34·0 | 39·9 | 18·4 | 43·3 | 19·2 | 28·7 | 38·4 | 21·9 |
| Mud mixed with sand .. | 22·4 | 20·8 | 26·9 | 30 0 | 28·2 | 30·0 | 30·1 | 32·0 | 20·8 | 20·4 |
| Algae .. | 19·8 | 40·0 | 19·3 | 30·1 | 40·8 | 24·9 | 39·9 | 21·0 | 24·6 | 43·7 |
| Diatoms .. | — | 2·8 | — | — | 2·0 | — | 2·8 | 5·8 | — | 4·0 |
| Molluscs .. | 10·0 | 18·2 | 9·8 | — | — | — | 8·0 | 10·0 | 16·2 | 7·8 |
| Miscellaneous matter .. | 4·0 | — | 10·0 | — | — | 1·8 | — | 2·5 | — | 2·2 |




*Pie diagrams showing the percentage average of the various food items of the Juveniles and adults of Mugil dussumieri, (A and B) and Mugil caeruleo-maculatus (C and D).*

Analyses of gut contents of fishes from the table No. 3 shows that decayed organic matter, mud and Algae formed the most important item of food with a few larval bivalves and gastropods. The decayed organic matter consisted mainly of decayed slimy mass of unidentifiable plant matter. It is also clear from the table that when the percentage of algal food was high, decayed matter consumed was very low. Species of *Oscillatoria* and *Anabuera* were the common algae identified from the gut contents. The important constituents of miscellaneous food items were green matter and sea weeds. From the fact that mud is found in a appreciable quantities, it may be presumed that this Grey mullet feeds along the sea bottom.

*Juveniles:*—Out of 66 juveniles examined except 12 all had food in the stomach. The analyses of the gut contents showed that copepods form the main item of food, *Oithona sp, Paracalunus sp* and *Centropages sp* being the commonest species. Very rarely diatoms and algae were present, but these could not be identified with any certainty since they were partly digested. Pie diagram C and D show the difference of diet between the juveniles and adults.

## Summary

(1) The analyses of the stomach contents of two species of Grey mullets, young *M. dussumieri* and young *M. caeruleo-maculatus* are presented and their feeding habits discussed.

(2) The juveniles of both the mullets feed on algae and small animals living near the surface and are omnivorous whereas their adults feed mainly on the bottom and are detritus feeders.

## Acknowledgement

I am extremely thankful to Dr. C. P. Gnanamuthu, M.A., D.Sc., F.Z.S., Director, University Zoology Research Laboratory for suggesting the problem and giving constant encouragement and useful suggestions throughout the period of investigation.

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# List of Indian Fungi — 1952-1956

BY

C. V. SUBRAMANIAN AND K. RAMAKRISHNAN
*University Botany Laboratory, Madras-5*

(Received for publication, 5th July, 1956)

This list of Indian fungi is a continuation of our second supplement to the fungi of India, which was published four years ago (*J. Madras Univ.*, B, 22: 1-65, 163-182). Considerable descriptive and taxonomic work on fungi has been carried out in this country since the publication of our second supplement and, as may be seen from this list, 765 new records of fungi (including new taxa) have been reported during this period. This, indeed, reflects the somewhat extensive mycological activity in this country during the four-year period, 1952-1956; in comparison, the second supplement which covered a much longer period (1938-1952) listed 812 new records. Analytical data on the number of fungi recorded, etc., in this list are given below:

| | Phycomycetes | Ascomycetes | Uredinales | Ustilaginales | Other Basidiomycetes | Fungi Imperfecti | Total |
|---|---|---|---|---|---|---|---|
| New species .. | 50 | 51 | 48 | 19 | 2 | 134 | 304 |
| New varieties .. | 2 | — | 1 | 4 | 1 | 7 | 15 |
| Other spp. recorded for the first time from India .. | 39 | 66 | 24 | 16 | 55 | 232 | 432 |
| Other varieties recorded for the first time .. | 2 | 1 | — | 1 | 1 | 7 | 12 |
| New formae .. | — | — | — | — | — | 2 | 2 |
| Total .. | 93 | 118 | 73 | 40 | 59 | 382 | 765 |

This brings the total number of fungi so far recorded from this country to 4445, excluding the myxomycetes which have been omitted from this list.

Apart from the quantitative data presented above, a brief resume may be given here of the highlights of Indian work during the period. In general, interest during the period shifted from studies on the Uredinales and the Ustilaginales to those on Phycomycetes and Fungi Imperfecti as may be seen from the analytical data given above. It may even be stated that much of the earlier work has been mainly on parasitic and foliicolous fungi, and attention is now being focussed on saprophytic forms as well. Some genera have received intensive systematic investigation: in the Phycomycetes work on *Physoderma* and *Synchytrium*, notably by Thirumalachar and his co-workers, by Lingappa, and by Gupta and Sinha; in the Hyphomycetes work on *Cercospora* by Thirumalachar and Govindu, and on *Curvularia* and *Periconia* by Subramanian.

Twenty-nine generic names have been proposed from India during the period: two in the Phycomycetes, five in the Ascomycetes, one in the Uredinales, two in the Ustilaginales, three in the Sphaeropsidales, one in the Melanconiales, and fifteen in the Moniliales. These are listed below:

*Phycomycetes*:

**Saksenaea** S. B. Saksena
**Sclerophthora** Thirum., Shaw & Naras.

*Ascomycetes*:

**Annajenkinsia** Thirum. & Naras.
**Bagcheea** Mueller & Menon
**Bitancourtia** Thirum. & Jenkins
**Discomycetella** Sanwal
**Sapucchaka** K. Ramakr.

*Uredinales*:

**Kulkarniella** Gokhale & Patel

*Ustilaginales*:

**Narasimhania** Thirum. & Pavgi
**Zundelula** Thirum. & Naras.

*Sphaeropsidales*:

**Anthasthoopa** C. V. Subram. & K. Ramakr.
**Petrakomyces** C. V. Subram. & K. Ramakr.
**Plagionema** C. V. Subram. & K. Ramakr.

*Melanconiales*:

**Rostrospora** C. V. Subram. & K. Ramakr.

*Moniliales*:

**Beltraniella** C. V. Subram.
**Biharia** Thirum. & Mishra
**Gliocladiopsis** S. B. Saksena
**Koorchaloma** C. V. Subram.
**Lacellinopsis** C. V. Subram.
**Lomaantha** C. V. Subram.
**Lomachashaka** C. V. Subram.
**Macraea** C. V. Subram.
**Monocillium** S. B. Saksena
**Paathramaya** C. V. Subram.
**Phaeotrichoconis** C. V. Subram.
**Prathigada** C. V. Subram.
**Prathoda** C. V. Subram.
**Starkeyomyces** V. Agnihotrudu
**Tharoopama** C. V. Subram.

Of these, *Plagionema* has been shown to be a synonym of *Ciliochorella* Sydow; *Macraea* Subram. 1952 is a later homonym of

*Macraea* Lindl. 1830 et Wight 1852 and a nom. nov., *Prathigada* had to be proposed. One generic name, viz., *Aulographopsis* Petrak, and its type, *A. indica* Petrak, both appear to be *nomina nuda*.

The fungi are arranged in alphabetical order under genera. The citation of each generic name is followed by a reference to Saccardo's *Sylloge Fungorum* (Vols. I-XXV), wherein a description of the genus could invariably be found. Where a genus name is not listed in the *Sylloge*, the original citation of the genus itself is given. In citing the authority for the generic names, we have followed Ainsworth and Bisby's *A Dictionary of the Fungi*, 4th Edition, 1954. After every generic name, its systematic position (class and order) is indicated and in certain cases the families or spore groups also, following Ainsworth and Bisby's *Dictionary*. The details of the symbols used to indicate spore groups are:

| | | |
|---|---|---|
| Spores 1-celled | Hyaline or bright | (A1) Hyalosporae |
| | Dark | (A2) Phaeosporae |
| Spores 2-celled | Hyaline or bright | (B1) Hyalodidymae |
| | Dark | (B2) Phaeodidymae |
| Spores 3- or more-celled | Hyaline or bright | (C1) Hyalophragmae |
| | Dark | (C2) Phaeophragmae |
| Spores muriform | Hyaline or bright | (D1) Hyalodictyae |
| | Dark | (D2) Phaeodictyae |
| Spores filiform | | (E ) Scolecosporae |
| Spores spirally coiled | | (F ) Helicosporae |
| Spores star-like | | (G ) Staurosporae |

The species are listed alphabetically within each genus and, where possible, the reference in Saccardo's *Sylloge* is given; in cases where a species is not listed in the *Sylloge* (Vols. I-XXV), the original reference itself is cited. In the citation of literature in the text, the following abbreviations have been used: **BB**, Butler and Bisby, The Fungi of India, 1931; **M**, Mundkur, Fungi of India, Supplement I, 1938; **RS**, Ramakrishnan and Subramanian, The Fungi of India—A second supplement, 1952; and **Sacc.**, Saccardo, Sylloge Fungorum.

Nomenclatural changes of some fungi reported in the previous lists of Indian fungi (*loc. cit.*) are indicated within square brackets.

A list of host genera and substrata arranged alphabetically is included.

A list of basonyms of the fungi listed as well as obligate and other synonyms, where necessary, has also been given in the hope

that it may be useful in ascertaining the occurrence of certain fungi which have received several names but listed here under names which appeared to us to be the correct ones: e.g., *Ophiobolus graminis* which has recently been recorded in this country is listed here as *Linocarpon cariceti;* it is also the type of the genus *Gaeumannomyces,* being known as *G. graminis.* The fungus is best known to phytopathologists as *Ophiobolus graminis* and its record in India under *Linocarpon* might be easily overlooked. The purpose of the synonymy list is precisely to avoid this. Since the specific epithets in the synonymy list are arranged alphabetically, with the corresponding generic names also arranged alphabetically and in parenthesis, a search for names of taxa under *graminis* would indicate whether *Ophiobolus graminis* has been recorded under that well-known or other names.

Finally, a systematic arrangement of the genera listed is also appended since this may again be useful and handy for reference.

ACKNOWLEDGEMENT

We are deeply indebted to Professor T. S. Sadasivan, but for whose encouragement this work could not have been completed and published.

## LIST OF FUNGI

**ABSIDIA** van Tiegh. (**Sacc. VII**, 214) Phyco., Mucorales, Mucoraceae.

**Absidia butleri** Lendner (*Bull. Soc. bot. Geneve,* ser. 2, 18: 181, 1926) isolated from soil, Sagar, M.P. (**221**: 279).

**A. glauca** Hagem (**Sacc. XXI**, 824). In ponds, Gauhati, Assam (**32**: 297).

**A. heterospora** Ling-Young (*Rev. gen. Bot.,* 42: 739, 1930-31) isolated from soil, Allahabad, U.P., (**178**: 120).

**A. spinosa** Lendner (**Sacc. XXI**, 824) isolated from soil, Madras (**183**: 55), Patharia forest, Sagar, M.P. (**221**: 272).

**ACHLYA** Nees ex? Pringsh. (**Sacc. VII**, 274) Phyco. Saprolegniales, Saprolegniaceae.

**A. klebsiana** Pieters (**Sacc. XXIV**, 27). In ponds, Gauhati, Assam (**32**: 296). The record in **M**: 8 is from Pakistan.

**ACHORION** Remak. is based on *Trichophyton schoenleini* (Leb.) Langer & Milochev. (**Sacc. XXII**, 1336 gives *Achorion* Lebert). The type species *A. schoenleini* (Lebert) Remak. is a *Trichophyton* fide Conant (**60**: 253).

**A. actoni** Dey and Mapleston, on man, Jaipur, Rajasthan (**81**: 697), on man (**77**: 416).

**A. indicum** Castellani = *A. concentricum* Blanchard, on man, Mymensingh, Bengal (**1**: 428). It is not clear whether this is the same as *Epidermophyton indicum* Castellani (syn. *Achorion indicum* Guiart & Grigorakis), see Dodge (**85**: 491).

**ACROSTALAGMUS** Corda = *Verticillium* Nees ex Wallr. but is often used, (**Sacc. IV**, 163). Imp. Moniliales, Moniliaceae (A).

**A. cinnabarinus** Corda (**Sacc. IV**, 163) isolated from soil, Sagar, M.P. (**221**: 283).

**ACTINICEPS** Berk. & Br. (**Sacc. IV**, 579), Imp. Moniliales, Stilbaceae (A1).

**A. cocos** C. V. Subram. on dead spathe of *Cocos nucifera* L., Rice Res. Station, Thirurkuppam, Chingleput District, Madras State (**257**: 36).

**ACTINODOCHIUM** Syd. (*Ann. mycol.* 25: 146, 1927). Imp., Moniliales, Tuberculariaceae (A2).

**A. jenkinsii** Uppal, Patel & Kamat, on fruits of *Mangifera indica* L. Vengurla, Bombay State (**294**: 44).

**AECIDIUM** Pers. (**Sacc. VII**, 774) Basidio.; Uredinales.

**A. anaphalis-leptophyllae** Ramakr., Sriniv., & Sund., on leaves of *Anaphalis leptophylla* DC., Sholada, near Ootacamund, Nilgiris (**192**: 87).

**A. barleriae** Salam & Ramachar, (*nomen nudum,* no diagnosis) on *Barleria* sp. (?), Hyderabad, Dn. (**225**: 213).

**A. gymnematis** Ramakr. & Sund., on living leaves of *Gymnema sylvestris* R. Br., Mannantoddy, Malabar (**196**: 190).

**A. iquitosense** P. Henn. (**Sacc. XVII**, 415). On leaves of *Psychotria elongata* Hk., Burliar, Nilgiris (**197**: 29).

**A. leeae** Salam & Ramachar,, on living leaves of *Leea macrophylla* Roxb., Osmania University Campus, Hyderabad, Dn., (**224**: 193).

**A. lophopetali** Wakefield (*Kew Bull.* No. 4, 203, 1931). On living leaves of *Lophopetalum wightianum* Arn., Dehra Dun, U.P. (Wakefield in *Kew. Bull.* No. **4**: 203, 1931).

**A. meliosmae-wightiae** Ramakr., Sriniv., & Sund., on living leaves of *Meliosma wightii* Planch., Ootacamund, Nilgiris (**192**: 87).

**A. nummulare** Berk. (**Sacc. VII**, 809). On living leaves of *Ceropegia intermedia* W., Kallar, Coimbatore Dt., (**193**: 87).

**A. paveniae-odoratae** Ramakr., Sriniv., & Sund., on leaves of *Pavonia odorata* Willd., Kallar, Coimbatore Dt., (**192**: 89).

**A. spilanthis** Ramakr. & Sund., on living leaves of *Spilanthes acmella* Mur. Valparai, Anamalais, Coimbatore Dt., (**199**: 143). See *Endophyllum spilanthes* also.

**A. urgineae** Ramachar (*nomen nudum*, no diagnosis) on *Urginea indica* Kunth, Hyderabad, Dn. (**182**: 216).

**A. walayarense** Ramakr. & Sund., on living leaves of *Cordia obliqua* Willd., Walayar, Malabar (**196**: 191).

**AGARICUS** L. ex. Fr., (Sacc. V, 993) Basidio. Agaricales, Agaricaceae.

**A. arvensis** Schaeff. (Sacc. V, 994). On soil, Calcutta (**208**: 14); on meadow and grassy pastures, Gauhati, Assam (**32**: 302).

**A. pratensis** Schaeff. (Sacc. V, 997). On ground, Gauhati, Assam (**32**: 302, without authority).

**AGLAOSPORA** de Not. (? = *Massaria*, Sphaeriales) (Sacc. II, 133).

**A. aculeata** Petch (Sacc. XXII, 397). On *Thea sinensis*, Jorhat, Assam (**32**: 300, without authority).

**ALBUGO** Pers. ex. S. F. Gray for *Cystopus* Lév. Phyco. Peronosporales, Albuginaceae. "*Albugo* seems to be the correct name under the new code" fide Ainsworth and Bisby (**6**: 97).

[**A. evolvuli** (Damle) Safee. & Thirum. (**210**: 282) as *Cystopus evolvuli* Damle in **RS**: 16. *Albugo evolvuli* (Damle) Ciferri & Biga in *Sydowia*, **9**: 354, 1955 is a later homonym.]

**A. evolvuli** (Damle) Safee. & Thirum. var. merremiae Safee. & Thirum. On leaves and shoots of *Merremia emarginata* Hall, Bangalore, Mysore (**212**: 226), Bariarpur, Bihar (**281**: 83).

**A. evolvuli** (Damle) Safee. & Thirum. var. **mysorensis** Safee. On leaves and stems of *Ipomoea hederacea* Jacq., Bangalore, Mysore (**209**: 288).

**A. ipomoeae-aquaticae** Sawada. On leaves, shoots and flower stalks of *Ipomoea aquatica* Forsk. (*I. reptans* Poir.), Bangalore, Mysore (**212**: 226).

**A. molluginis** S. Ito apud Ito & Tokunaga (*Trans. Sapporo. nat. Hist. Soc. Japan*, **14**: 18, 1935). On *Mollugo cerviana* Sr., Bangalore, Mysore (**210**: 282) *Cystopus molluginicola* Ramakr. T. S. & K. in **RS**: 16 is a synonym of this fungus fide Safeeulla (**210**: 282).

**A. pratapi** K. Damle. In shoots of *Merremia emarginata* Hallier (as *Ipomoea reniformis* Chois,) Amalner, E. K., Bombay state (**67**: 156).

**ALLOMYCES** Butler (Sacc. XXIV, 31). Phyco. Blastocladiales, Blastocladiaceae.

[**A. macrogynus** (Emerson) Emerson & Wilson (**86**: 429). Reported as *A. javanicus* Kniep var. *macrogynus* Emerson in **RS**: 6.]

**ALTERNARIA** Nees ex Wallr. (Sacc. IV, 545). Imp. Moniliales, Dematiaceae (D).

**A. amaranthi** (Peck) Venkatakrishnaiah (Sacc. XIV, 1036 as *Macrosporium amaranthi* Peck). On stems, leaves and flowers of *Amaranthus paniculatus* L., Govt. Central Farm, Hebbal, Bangalore, Mysore (**298**: 696). It is not stated whether the type of *Macrosporium amaranthi* was seen.

**A. humicola** Oud. (Sacc. XVIII, 624). Isolated from paddy field soil, Chinsurah, Bengal (**207**: 29; **251**: 219), Gauhati, Assam (**32**: 308, without authority); isolated from soil, Sagar, M.P. (**221**: 280). Record in **M**: 30 is from Pakistan.

**A. oryzae** Hara (*J. agric. Soc. Japan*, 32: 52, 1928). On rice grains, Hyderabad, Dn. (**151**: 123, without authority).

**A. porri** (Ell.) Neerg. (Sacc. IV, 537 as *Macrosporium porri* Ell.). On leaves of onion, College of Agriculture, Sabour, Bihar (282: 146).

**A. ricini** (Yoshii) Hansford (*Proc. Linn. Soc. Lond.*, 155th session, 34-67, 1943) causing blight of *Ricinus communis* L., Kanpur, U.P. (236: 138).

**A. sesamicola** Kamamura (*Fungi Nippon Fungologicae Soc.*, 1: 29, 1931). On living leaves of *Sesamum orientale* L., Titabar, Assam (56: 84).

**AMAURODERMA** (Pat.) Murrill is near *Ganoderma* (Sacc. XXIII, 406, etc., under *Ganoderma*) Basidio. Agaricales, Polyporaceae.

[**A. scopulosum** (Berk.) Imazeki (in *Bull. Govt. For. Exp. Sta. Tokyo*, 57: 99, 1952) as *Polyporus scopulosus* Berk., in BB: 119].

**AMAZONIA** Theiss. (Sacc. XXIV, 504). Asco. Erysiphales, Meliolaceae.

**A. butleri** (Syd.) Stevens (*Ann. mycol.* 25: 415, 1927; Sacc. XXIV, 338 as *Meliola butleri* Syd.). On *Citrus nobilis* Lour, K & J. Hills, Assam (32: 298). Records in BB: 28 are from Pakistan and Burma as *Meliola butleri*.

**AMPHISPHAERIA** Ces. & de Not. (Sacc. I, 718). Asco. Sphaeriales, (B2).

**A. lantanae** K. Ramakr. On dead stems of *Lantana camara* L. var. *aculeata* Mold., University Botany Laboratory campus, Madras (187: 251).

**ANCYLISTES** Pfitzer (Sacc. VII, 280). Phyco. Entomophthorales. Entomophthoraceae.

**A. berdanii** Sparrow (*Trans. Brit. mycol. Soc.*, 38: 217, 1955). Parasitic on *Closterium* sp., in water, Lucknow, U.P. (119: 88 as *A. pfeifferi* Beck.) Sparrow (241: 217) suggests that A. *pfeifferi* Beck should be rejected as it is based on a mixture of fungi. It should be termed *A. berdanii* Sparrow, sp. nov.

**A. closterii** Pfitzer (Sacc. VII, 280). Parasitic on *Closterium* sp., in water, Lucknow, U.P. (119: 88).

**ANGIOPSORA** Mains (*Mycologia*, 26: 126, 1934.). Basidio. Uredinales, Pucciniaceae.

**A. cyrtococci** Ramakr. & Sund. On living leaves of *Cyrtococcum oxyphyllum* Stapf, Periakallar, Anamalais, Coimbatore District (199: 144).

**ANNAJENKINSIA** Thirum. & Naras. (*Mycologia*, 47: 760, 1955). Asco. Myriangiales, (C1).

**A. fungicola** Thirum. & Naras. On *Phyllachora amphididyma* Penzig & Sacc. on *Salacia* sp., Coorg, S. India (285: 760).

**ANNELLOPHORA** Hughes (*Trans. Brit. mycol. Soc.*, 34: 544, 1951). Imp. Moniliales, Dematiaceae (C).

**A. indica** C. V. Subram. On living leaves of *Photinia* sp., Kodaikanal, Madura Dt., Madras State (260: 53-54).

**ANTHASTHOOPA** C. V. Subram. & K. Ramakr. (*Proc. Indian Acad. Sci.*, B, 43: 173, 1956) Imp., Sphaeropsidales, Sphaerioidaceae (A1).

**A. simba** C. V. Subram. & K. Ramakr. On dead pods of *Caesalpinia pulcherrima* Sw., University Botany Laboratory campus, Madras (*Proc. Indian Acad. Sci.*, B, 43: 174).

**ANTHOSTOMELLA** Sacc. (Sacc. I, 278). Asco., Sphaeriales (A2).

**A. hibisci** K. Ramakr. On dead stems of *Hibiscus rosa-sinensis* L., 'Shri Bagh', Ernakulam, T. C. State (187: 249).

**ANTROMYCOPSIS** Pat. & Trab. (Sacc. XIV, 1120). Imp. Moniliales, Stilbaceae (A2).

**A. broussonetiae** Pat. & Trab. var. **minor** Penz. & Sacc. (Sacc. XVIII, 652). On dead wood, Madras (257: 37).

**APHYSA** Theiss. & Syd. (Sacc. XXIV, 400). Asco., Hemisphaeriales, Polystomellaceae.

**A. rhynchosiae** (Kalchbr. & Cke.) Theiss. & Syd. (**Sacc. XXIV**, 400; **Sacc. I**, 543 as *Stigmatea rhynchosiae*). On living leaves of *Rhynchosia cyanosperma* Benth., Ootacamund, Nilgiris, Madras State (**193**: 84).

**APIOCREA** Syd. (**Sacc. XXIV**, 675) =*Hypomyces* fide Clements & Shear. Asco. Hypocreales (B1).

[**A. chrysosperma** (Tul.) Syd. (*Ann. mycol.* 18: 187, 1920) Basonym: *Hypomyces chrysospermus* Tul. (**Sacc. II**, 467). A fungus under the latter name has been reported from Khasi Hills, on? *Boletus* sp., in **BB**: 24].

**ARTHRINIUM** Kunze ex Fr. (**Sacc. IV**, 279). Imp. Moniliales, Dematiaceae (A) or Tuberculariaceae (A2).

**A. saccharicola** Stevens apud Johnston & Stevenson (**Sacc. XXV**, 771). On dead stems, Thanthipandal, Kambakkam, Chingleput Dt., Madras State (**249**: 160).

**ARTHROBOTRYUM** Ces. (**Sacc. IV**, 628). Imp. Moniliales, Stilbaceae (C2).

**A. coonoorense** C. V. Subram. On living leaves of *Thysanolaena maxima* (Roxb.) Kuntze, Sim's Park, Coonoor, Niligiris, Madras State (**258**: 285).

**A. melanoplaca** Berk. & Curt. (**Sacc. IV**, 829). Parasitic on colonies of *Meliola salaciae* Hansf., Balehonnur, Mysore (**280**: 125).

**ARTHURIA** Jackson (*Mycologia*, 23: 463, 1931). Basidio. Uredinales, Pucciniaceae.

**A. glochidionis** Gokhale, Patel & Thirum. On living leaves of *Glochidion* sp., Mahableshwar, Bombay State (**101**: 246).

**ASCHERSONIA** Mont. (**Sacc. III**, 619). Imp. Sphaeropsidales, Nectrioidaceae.

**A. papillata** Petch (*Trans. Brit. mycol. Soc.*, 10: 195, 1924-26). On Aleyrodid insects on *Leucas aspera*, Kakolat, Bihar (**281**: 81); on *Dialeurodes citri*, Bhumital (**39**: 79).

**ASCOBOLUS** Pers. ex. Fr. (**Sacc. VIII**, 514). Asco. Pezizales.

**A. immersus** Pers. (**Sacc. VIII**, 523). On horse dung, Delhi (**229**: 198).

**A. indicus** Sanwal. On cow dung, Delhi (**230**: 202).

**A. magnificus** Dodge (**Sacc. XXIV**, 1221). On the ground (**72**: 87; **251**: 208).

**ASCOCHYTA** Lib. (**Sacc. III**, 384). Imp. Sphaeropsidales, Sphaerioidaceae.

**A. commiphorae** Ramakr. & Sund. On living leaves of *Commiphora caudata* Engl. Aduthurai, Tanjore Dt., Madras State (**199**: 146).

**A. sorghi** Sacc. (**Sacc. III**, 406). On leaves of *Andropogon sorghum* Brot., *A. sorghum* v. *sudanense* and *A. halepensis*, Kanpur, U.P. (**237**: 45).

**ASEROE** La Bill. ex Fr. (**Sacc. VII**, 25). Basidio. Phallales.

**A. rubra** (La Bill.) v. **ceylanica** (Berk.) Ed. Fischer (**Sacc. VII**, 25 as *A. zeylanica* Berk.), Kodaikanal, Pulney Hills, Madras State; Munnar, W. Ghats (**113**: 257).

**ASPERGILLUS** Mich. ex Fr. (**Sacc. IV**, 64). Imp. Moniliales, Moniliaceae (A).

**A. alliaceus** Thom & Church (**293**: 244). Isolated from soil, Allahabad, U.P. (**178**: 120, without authority).

**A. atropurpureus** Zimmermann (**293**: 226). On cotton and jute, Calcutta (**7**: 419, without authority). *A. atropurpureus* Blochwitz (1934) is a probable synonym of *A. niger* v. Tiegh. (fide Thom & Raper, **293**: 225). *A. atropurpureus* Zimm. is a valid species. Since the authority is not cited in the above record we take it that *A. atropurpureus* Zimm. is meant.

**A. awamori** Nakazawa (**293**: 220). Isolated from soil samples collected from paddy fields at the State Agricultural Farm, Chinsurah, Bengal (**47**: 93).

**A. candidus** Link. (**Sacc. IV**, 66; **293**: 207). From atmosphere, Kanpur, U.P. (**181**: 36).

**A. clavatus** Desm. (Sacc. IV, 67; 239: 92). Isolated from paddy soils, Gauhati, Assam (32: 297, without authority); isolated from soil samples from paddy fields at the State Agricultural Farm, Chinsurah, Bengal (47: 93).

**A. flavipes** (Bain. & Sart.) Thom & Church (293: 179). Isolated from soil, Allahabad, U.P. (215: 31) and Sagar, (221: 272). The record in **M**: 31 is from Pakistan.

**A. giganteus** Wehmer (Sacc. XVI, 1029; 293: 95). Isolated from the rhizosphere of crop plants, Madras (5: 99).

**A. glaucus** Link (Sacc. IV, 64; Thom and Raper (293) do not mention this species in their list of accepted species, etc., in pp. 360-61). Isolated from paddy soils, Gauhati, Assam (32: 297), from atmosphere, Kanpur, U.P. (181: 36, without authority).

**A. niveus** Blochwitz (293: 202). Isolated from soil, Sagar, M.P. (221: 276).

**A. proliferans** G. Smith (293: 117). Isolated from soil, Allahabad, U.P. (178: 120, without authority); on jute cloth, Calcutta (34: 190, without authority).

**A. sclerotiorum** Huber (293: 278)., Isolated from soil, Sagar, M.P. (221: 280).

**A. terreus** Thom (Sacc. XXV, 659; 293: 195). From atmosphere (181: 36, without authority); isolated from soil, Gauhati, Assam (32: 308), Sagar, M.P. (221: 274). Vandalur, Chingleput Dt. Madras State (183: 71; 186: 112); on jute cloth, Calcutta (34: 190 without authority). The record in **BB**: 140 is from Burma.

**A. versicolor** (Vuill.) Tiraboschi (293: 190). Isolated from soil, Sagar, M.P. (221: 272); causing rice spoilage, Calcutta (141: 126, without authority). The record in **M**: 31 is from Pakistan.

**A. violaceo-fuscus** Gasperini (293: 231; Sacc. X, 526 as *Sterigmatocystis violaceo-fusca* (Gasp.) Sacc.). Isolated from soil samples of paddy fields at State Agricultural Farm, Chinsurah, W. Bengal (47: 94).

**A. wentii** Wehmer (Sacc. XIV, 1045; 293: 246). Isolated from soil, Allahabad, U.P. (178: 120, without authority).

**ASTEROCONIUM** Syd. (Sacc. XVIII, 493). Imp. Melanconiales (G).

**A. nothopegiae** Ramakr., Sriniv. & Sund. On leaves of *Nothopegia dalzellii* Gamb., Naduvattam, Nilgiris, Madras State (193: 93).

**ATELOSACCHAROMYCES** Beurmann & Gougerot. ? A nomen dubium.

**A. moachoi** Froilano de Mello. On "Acajonsaft" on the fruit of *Anacardium occidentale* Linn., Portuguese India (F. de Mello in *C. R. Soc. Biol.*, 84: 997, 1920).

**AULOGRAPHOPSIS** Petrak apud Mitter & Tandon (*J. Indian bot. Soc.*, 17: 181, 1938. No generic diagnosis given.).

**A. indica** Petrak. On *Pteris* sp., Naini Tal, U.P. (149: 181 without diagnosis).

**AURICULARIA** Bull. ex Merat. (Sacc. VI, 762). Basidio. Tremellales, Auriculariaceae.

**A. rosea** Burt. On wood, Bengal (208: 15).

**BAGCHEEA** Mueller & Menon (*Phytopath. Z.*, 22: 417, 1954). Asco. Sphaeriales, Cryptosporellaceae, Hyalosporae.

**B. castaneae** Mueller & Menon. On leaves of *Castanea* sp., Kotagiri, Madras State (154: 418).

**BALANSIA** Speg. (Sacc. IX, 997). Asco. Hypocreales, (E).

**B. claviceps** Speg. (Sacc. IX, 997). In inflorescence of *Cyrtococcus oxyphyllum* Stapf (= *Panicum pilipes* Nees ex Ar.), Malabar (193: 83).

**BASIDIOPHORA** Roze & Cornu (Sacc. VII, 293 under *Plasmopara*). Phyco. Peronosporales, Peronosporaceae.

**B. butleri** (Weston) Thirum. & Whitehead. On *Eragrostis plumosa* Lamk., Bangalore, Mysore (291: 418).

**BEAUVERIA** Vuill. (Sacc. XXV, 696). Imp. Moniliales, Moniliaceae (A).

**B. bassiana** (Bals.) Vuill. (Sacc. XXV, 696). On the larva of *Haplocerambyx spinicornis* and on longicorn larva, Dehra Dun, U.P. (176: 59).

**BELTRANIA** Penzig (Sacc. IV, 377). Imp. Moniliales, Dematiaceae (B).

**B. indica** C. V. Subram. On the pods of *Caesalpinea pulcherrima* Sw., University Botany Laboratory campus, Madras (248: 45).

**BELTRANIELLA** C. V. Subram. (*Proc. Indian Acad. Sci.* 36B: 227, 1952). Imp. Moniliales, Dematiaceae (A).

**B. odinae** C. V. Subram. On dead leaves of *Odina wodier* Roxb., University Botany Laboratory campus, Madras (250: 227).

**BENIOWSKIA** Racib. (Sacc. XVI, 1091). Imp., Moniliales, Tuberculariaceae (A1).

**B. graminis** Racib. (Sacc. XVI, 1091). On living leaves of *Pennisetum hohenackeri* Hochst., Wynad, Malabar, Madras State (196: 193).

**BIHARIA** Thirum. & Mishra (*Sydowia*, 7: 79, 1953). Imp., Moniliales, Dematiaceae (E).

**B. vangueriae** Thirum. & Mishra. On leaves of *Vangueria spinosa* Roxb., Darbhanga, Bihar (281: 79).

**BITANCOURTIA** Thirum. & Jenkins (*Mycologia*, 45: 781, 1953). Asco., Myriangiales (C1).

**B. cassythae** Thirum. & Jenkins. On stems of *Cassytha filiformis* L., Yeshvantapur, Bangalore (278: 782).

**BLASTOCLADIA** Reinsch (Sacc. XI, 245; 240: 428) Phyco., Blastocladiales.

**B. globosa** Kanouse (240: 435). On submerged fruits, Lucknow, U.P. (69: 167).

**B. ramosa** Thaxter (Sacc. XIV, 456; 240: 440). On submerged fruits, Lucknow, U.P. (69: 167).

**B. sparrowii** Indoh (240: 433). On submerged fruits, Lucknow, U.P. (69: 165).

**BLODGETTIA** Wright (Sacc. X, 664) Imp., Moniliales, Dematiaceae (C).

**B. indica** C. V. Subram. On dead stubble submerged in water in flower pots, Madras (257: 38).

**BOTRYODIPLODIA** Sacc. (Sacc. III, 377). Imp., Sphaeropsidales, Sphaerioidaceae (B2).

[**B. phaseoli** (Maubl.) Thirum. (272: 610). On potato, Patna, Bihar. Recorded in **BB:** 158 as *Macrophomina phaseoli* (Maubl.) Ashby. In so far as the type of Maublanc's fungus has not been examined and proved to contain phaeodidymospores, it is doubtful if the combination *Botryodiplodia phaseoli* (Maubl.) Thirum. is valid].

**BOTRYOSPHAERIA** Ces. & de Not. (Sacc. I, 456). Asco., Sphaeriales (A1).

**B. ribis** Grossb. & Duggar (Sacc. XXIV, 813). On stems of apple, Government orchard, Chaubattia, Kumaon, U.P. (238: 368).

**BOTRYOSPORIUM** Corda (Sacc. IV, 54) Imp., Moniliales, Moniliaceae (A).

**B. longibrachiatum** (Oudem.) Maire (Sacc. XVIII, 510). On decayed plant material, Cuttack, Orissa (160: 215); on dead plants of *Arachis hypogea*, Madras (261).

**BOUDIERA** Cooke (Sacc. VIII, 512) Asco., Pezizales.

**B. seaveri** Sanwal. On the surface of damp soil, Kalika, Kumaon, U.P. (229: 194).

**CALLORIOPSIS** Sydow (**Sacc. XXIV**, 1242) Asco., Helotiales.

**C. gelatinosa** (Ell. & Mart.) Sydow (**Sacc. XXIV**, 1242). Parasitic on colonies of *Meliola tenella* Pat., on *Murraya exotica* L., Nandi Hills, Mysore (**280:** 124).

**CAMPTOMERIS** Sydow (*Ann. mycol.*, **25:** 142, 1927) Imp., Moniliales, Tuberculariaceae (C2).

[**C. acaciae** (Sydow) Cif. (*Mycopath.* **6:** 25, 1951). Recorded as *Septogloeum acaciae* Sydow in **BB:** 163. Bessey (**28:** 385) states: "The fact that Sydow states that the conidiophores are lacking ("sporophoris nullis") and that the "acervuli" are subcutaneous and that the spores emerge in light yellow drops would seem to bar this from inclusion in *Camptomeris*"].

[**C. albizziicola** (Thirum. & Naras.) Bessey (**28:** 383). Recorded in **RS:** 23 as *Helminthosporium albizziicolum* Thirum. & Naras].

**C. crataevae** C. V. Subram. On living leaves of *Crataeva religiosa* Forst., Agri-Horticultural Society's Gardens, Madras (**249:** 167).

**CANDIDA** Berkhout (Die schimmelgeslachten *Monilia, Oidium, Oospora,* en *Torula,* Diss. Utrecht, **1923**, p. 41) Imp., Moniliales, Pseudosaccharomycetaceae.

[**C. albicans** (Robin) Berkhout (**85:** 279; **60:** 142). On man, India (as *Monilia psilosis* Ashford and *Monilia albicans* Robin in **BB:** 148); on man, Calcutta (as *Monilia pinoyi* Castellani & Chalmers (without authority) in **163:** 138) ].

**C. guilliermondii** (Cast.) Langeron & Guerra (**139:** 518) Isolated from sea water, Bombay (**30:** 13, **31:** 26, without authority).

**C. melibiosi** Lodder & Kreger van Rij (**139:** 672). Isolated from sea water, Bombay (**30:** 13, **31:** 26, without authority).

**C. tamarindi** Lewis & Johar. On extracts of tamarind pulp, Mysore (**129:** 220. No diagnosis given for the new species, but the authors state: "We feel that this is a new strain").

**C. tropicalis** (Cast.) Berkhout (**139:** 502) Isolated from sea water, Bombay (**30:** 13, **31:** 26, without authority).

**CAPNODIUM** Mont. (**Sacc. I**, 73). Asco., Dothideales, Capnodiaceae.

**C. citri** Berk. & Desm. (**Sacc. I**, 78). On leaves, twigs and fruits of *Citrus* sp., Assam (**57:** 164).

**CARLOSIA** Arnaud (*Bull. Soc. mycol. Fr.*, **69:** 294, 1954). Imp., Moniliales, Dematiaceae (D).

**C. meliolae** (Zimm.) Arnaud (*Bull. Soc. mycol. Fr.* **69:** 294, 1954; **Sacc. XVIII**, 690, as *Spegazzinia meliolae* Zimm.). Parasitic on colonies of *Meliola salaciae* Hansf. on *Salacia* sp., Balehonnur, Mysore (**280:** 125). The record in **BB:** 149 is from Pakistan.

**CASTELLANIA** Dodge (**85:** 246) = *Candida* fide Diddens & Lodder.

**C. bronchialis** (Cast.) Dodge (**85:** 246, 254). On man. Calcutta (**163:** 138 as *Monilia bronchialis,* without authority).

**C. nabarroi** (Cast. & Chalmers) Dodge (**85:** 253). On man, Calcutta (**163:** 138 as *Monilia nabarroi,* without authority).

**C. paratropicalis** (Cast.) Dodge (**85:** 264). On man, Calcutta (**89:** 478 as *Monilia paratropicalis* Cast.).

**CEPHALIOPHORA** Thaxter (**Sacc. XVIII**, 544) Imp., Moniliales, Moniliaceae (C).

**C. irregularis** Thaxter (**Sacc. XVIII**, 545). On dead and decaying moist wood, Madras (**252:** 96).

**CEPHALOSPORIUM** Corda (**Sacc. IV**, 56) Imp., Moniliales, Moniliaceae (A).

**C. curtipes** Sacc. (**Sacc. IV**, 57). On rotting seeds of castor, Ajmer (**120**: 249).

**C. indicum** Petch. On caterpillars, Mooply Valley, S. India; on larvae of *Eublemma amabilis*, Namkum, Ranchi (**177**: 234-35).

**C. roseo-griseum** Saksena. Isolated from soil, Patharia forest, near Sagar, M.P. (**222**: 895; **221**: 279).

**CERATOCYSTIS** Ell. & Halst. (**Sacc. X**, 215, under *Sphaeronaema*) Asco, Sphaeriales (A1).

[**C. adiposa** (Butler) Moreau (*Rev. Mycol., Paris,* 17, *Suppl. Col.,* **No. 1**, **p.** 22, 1952). Recorded as *Ceratostomella adiposum* (Butler) Sartoris in **BB**: 19].

[**C. paradoxa** (Dade) Moreau (*Rev. Mycol., Paris, 17, Suppl. Col.,* **No. 1**, **p.** 22, 1952). Recorded as *Ceratostomella paradoxa* (de Seynes) Dade in **BB**: 19. *Endoconidiophora paradoxa* (de Seynes) Davidson (*J. agric Res.,* **50**: 800, 1935) is another name for the fungus. Under *Ceratocystis*, the citation should be: *C. paradoxa* (de Seynes) Moreau].

**CERATOSPHAERIA** Niessl. (**Sacc. II**, 227). Asco., Sphaeriales (A1).

**C. crossandrae** K. Ramakr. On dead stems of *Crossandra undulaefolia* Salisb., University Botany Laboratory campus, Madras (**187**: 252).

**CERCOSPORA** Fres. (**Sacc. IV**, 431) Imp., Moniliales, Dematiaceae (E).

**C. acanthacearum** Govindu & Thirum. On leaves of *Justicia betonica* L., Nandi Hills, Mysore (**105**: 221).

**C. adhatodae** Chowdhury. On living leaves of *Adhatoda vasica* Nees, Kokilamukh, Assam (**56**: 84).

**C. althaeina** Sacc. (**Sacc. IV**, 440). On leaves of *Kydia* sp., Hardinge Park, Patna, Bihar (**275**: 311).

**C. andrographidis** Thirum. & Govindu. On leaves of *Andrographis* sp., Patna, Bihar (**275**: 310).

**C. anisomelicola** Sawada (*Formosa (Taiwan) Agr. Res. Inst. Rep.* 86: 166, 1943). On leaves of *Anisomeles malabarica* R. Br., Bannerghatta, Bangalore (**105**: 228).

**C. artocarpi** H. & P. Sydow (**Sacc. XXV**, 884). On leaves of *Artocarpus incisa* Bangalore, (**277**: 348).

**C. atylosiae** Thirum. & Govindu. On leaves of *Atylosia scarabaeoides* Benth., Hebbal, Bangalore (**275**: 311).

**C. biharica** Thirum. & Govindu. On leaves of *Ampelocissus latifolia* Planch., Sabour Agricultural College, Bihar (**277**: 343).

**C. bertrandii** Chupp (*A Monograph of the fungus genus Cercospora,* p. 110, 1953). On leaves of *Chenopodium ambrosioides* L., Yadur, Bangalore (**105**: 223).

**C. blainvilleae** Govindu & Thirum. On leaves of *Blainvillea latifolia,* Hebbal, Bangalore (**106**: 226).

**C. boerhaavicola** Thirum. & Govindu. On leaves of *Boerhaavia diffusa* L., Patna, Bihar (**274**: 45).

**C. breyniae-rhamnoides** Thirum. & Govindu. On leaves of *Breynia rhamnoides* Muell., Nandi Hills, Mysore (**275**: 310).

**C. cadabae** Thirum. & Govindu. On leaves of *Cadaba indica* L., Yeshwantpur and Malleswaram, Mysore State (**274**: 45).

**C. californiensis** Chupp (*A Monograph of the fungus genus Cercospora,* p. 411, 1953). On leaves of *Nymphaea* sp., Lalbagh, Bangalore (**105**: 221).

**C. canavaliae** H. & P. Sydow (**Sacc. XXV**, 879). On leaves of *Canavalia ensiformis* DC., Patna, Bihar (**274**: 46).

C. **cardiospermi** Petch (Sacc. XXV, 890). On leaves of *Cardiospermum helicacabum* L., Bannerghatta, Bangalore (105: 226).

C. **caricis** Oudem. (*Nederl. Kruidk. Archief*, II, 6: 59, 1832). On leaves of *Eleocharis fistulosa* Boeck., Bannerghatta, Bangalore (105: 224).

C. **cassiae-montanae** Govindu & Thirum. On leaves of *Cassia montana* Heyne, Savandurga, Mysore (105: 224).

C. **catappae** P. Henn. (Sacc. XVIII, 593). On leaves of *Terminalia crenulata* Roxb., Bangalore (277: 348).

C. **celastricola** Govindu & Thirum. On leaves of *Celastrus paniculata* Willd., Savandurga, Mysore (105: 226).

C. **celosiae** Sydow (*Ann. mycol.*, 27: 430-31, 1929). On leaves of *Celosia argentea* L., Savandurga, Mysore (105: 222).

C. **chloroxyli** Ramakr. & Reddy. On leaves of *Chloroxylon swieteniae* DC., Kallar (Coimbatore Dt., Madras State). (189: 121).

C. **chrysanthemi** Heald & Wolf (Sacc. XXV, 871). On leaves of *Centratherum anthelminticum*, Bannerghetta, Bangalore (105: 222).

C. **cipadessae** Govindu & Thirum. On leaves of *Cipadessa baccifera* Miq., Nandi Hills, Mysore (105: 226).

C. **corchori** Sawada (*Agr. Exp. Sta. Formosa, Special Bull.* 37: 667, 1919). On leaves of *Corchorus tridens* L., Hebbal, Bangalore (106: 226).

C. **corchorifolia** Thirum. & Govindu. On leaves of *Melochia corchorifolia* L., Bannerghatta, Bangalore (277: 347).

C. **cyperi-rotundi** Thirum. & Govindu. On leaves of *Cyperus rotundus* L., Patna, Bihar (275: 312).

C. **diazu** Miuri (*Bull. S. Manchuria Railway Comp. Agric. Exp. Sta.* 1921). On soyabean, U.P. (145: 24-28).

C. **diffusa** Ell. & Ev. (Sacc. X, 635). On leaves of *Lycopersicon esculentum* Mill., Savandurga, Mysore (105: 226).

C. **effusa** (Berk. & Curt.) Ellis (Sacc. IV, 447; as *Cladosporium effusum* in Sacc. IV, 362). On living leaves of *Lobelia excelsa* Lesch., Coonoor, Ootacamund, Madras State (202: 63).

C. **erythroxylonis** Govindu & Thirum. On leaves of *Erythroxylon monogynum* Roxb., Nandi Hills, Mysore (106: 221).

C. **eugeniae** (Rangel) Chupp (*A Monograph of the fungus genus Cercospora*, p. 406-407, 1953). On leaves of *Eugenia* sp., Parasnath, Bihar (277: 344).

C. **eupatoricola** Govindu & Thirum. On leaves of *Eupatorium reevesii* Wall., Sibpur, Calcutta (105: 225); on leaves of *Eupatorium glandulosum*, Hosamande, Nilgiris, Madras State (106: 224).

C. **fagopyri** Mueller & Chupp (*Bol. Soc. Vnez. Cien nat.* 8: 35-39, 1942). On leaves of *Fagopyrum cymosum* Meisson, Shillong, Assam (56: 85).

C. **fici** Heald & Wolf (Sacc. XXV, 835). On leaves of *Ficus* sp., Sibpur, Calcutta (105: 227).

C. **fleuryae** Thirum. & Govindu. On leaves of *Fleurya interrupta* Gaud., Patna, Bihar (274: 46).

C. **fuligena** Roldan (*Philipp. J. Sci.*, 56: 8, 1938). On tomato leaves, Nagpur, M. P. (116: 43), Bhubaneshwar, Orissa (150: 270).

C. **galactiae** Ell. & Ev. (Sacc. XIV, 1100). On living leaflets of *Galactia tenuiflora* W. & A., Kallar, Madras State (198: 64).

C. **gliricidiae** Sydow (Sacc. XXV, 880). On living leaves of *Gliricidia maculata* L., Pattambi, Malabar, Madras State (201: 195).

**C. grewiae** Srivastava & Mehta. On living leaves of *Grewia asiatica* L., Kanpur, U.P. (244: 69).

**C. grewiicola** Govindu & Thirum. On leaves of *Grewia* sp., Kallar, Madras State (105: 229).

**C. haematoxylonis** Chupp (*A Monograph of the fungus genus Cercospora*, p. 309-310, 1953). On leaves of *Haematoxylon compacheanum*, Sibpur, Calcutta, (105: 228).

**C. hardwarensis** Naras. On leaves of *Tephrosia purpurea* Pers., Hardwar, U.P., (105: 227).

**C. hydroleae** Thirum. & Govindu. On leaves of *Hydrolea zeylanica* Vahl, Patna, Bihar (275: 310).

**C. insulana** (Sacc.) Chupp (*Bothalia*, 4: 887, 1948; Sacc. XXV, 914 as *Cercosporina insulana* Sacc.). On living leaves and flowering shoots of *Statice* sp., Ootacamund, Conoor, Madras State (202: 63 as *Cercospora insulana* Sacc.).

**C. jasminicola** Mueller & Chupp (*Arq. Inst. Biol. veg.* 3: 93, 1936). On living leaves of *Jasminum grandiflorum* L., Coimbatore (201: 195).

**C. jujubae** Chowdhury. On leaves of *Zizyphus jujuba* Lamk., Maulvibazar, Assam (54: 525).

**C. kirganelliae** Thirum. & Govindu. On leaves of *Kirganellia reticulata* Baill., Hebbal, Bangalore (275: 309).

**C. knoxiae** Govindu & Thirum. On leaves of *Knoxia corymbosa* Willd., Dodabetta, Nilgiris, Madras State (106: 223).

**C. kopkeii** Krueg (Sacc. X, 656). On sugarcane, Jorhat, Assam (161: 108, without authority), Kamrup, Assam (32: 309).

**C. krugiana** Mueller & Chupp (*Arq. Inst. Biol. veg.* 3: 94, 1936). On leaves of *Boehmeria nivea* Hook. & Arn., Gaud, Bangalore (106: 225).

**C. lepidagathidis** Govindu & Thirum. On leaves of *Lepidagathis cuspidata* Nees, Sitalayyanagiri, Bababudans, Mysore (106: 222).

**C. leucadis** Thirum. & Govindu. On leaves of *Leucas mollisima* Wall., Patna, Bihar (274: 46).

**C. lippiae** Ell. & Ev. (Sacc. X, 632). On leaves of *Lippia nodiflora* (L.) Michx., Nakhas Pind, Patna, Bihar (277: 346).

**C. maculicola** Thirum. & Govindu. On leaves of *Bidens pilosa* L., Hebbal, Bangalore (277: 344).

**C. medicaginis** Ell. & Ev. (Sacc. X, 622). On leaves of *Medicago sativa* L., Hebbal, Bangalore (106: 225).

**C. merremiae** Mendoza (*Philipp. J. Sci.*, 75: 172, 1941). On leaves of *Merremia emarginata* Hall., Phulwarisheriff, Patna, Bihar (277: 347).

**C. moringae** Thirum. & Govindu. On leaves of *Moringa oleifera* Lam., Allahabad, U.P. (274: 47).

**C. nothopegiae** Ramakr., Sriniv. & Sund., On living leaves of *Nothopegia dalzelliae* Gamb., Naduvattam, Nilgiris, Madras State (193: 94).

**C. nilghirensis** Govindu & Thirum. On leaves of *Conyza ambigua*, Hosamande, Nilgiris, Madras State (106: 224).

**C. occulata** Ell. & Kellerm. v. **indica** Govindu & Thirum. On leaves of *Veronia bourneana*, Sitalayyanagiri, Bababudans, Mysore (106: 223).

**C. patouillardi** Sacc. & D. Sacc. (Sacc. XVIII, 608). On *Calotropis procera* Br., Allahabad, U.P. (214: 208).

**C. peristrophes** Thirum. & Govindu. On leaves of *Peristrophe bicalyculata* Nees, Patna, Bihar (274: 47).

C. **piaropii** Tharp (**Sacc. XXV**, 914 as *Cercosporina piaropi* (Tharp) Sacc.). On leaves of *Eichhornia crassipes* Solms., Gulzaribagh. Patna, Bihar (**277**: 346).

C. **plumeriae** Chupp. On *Plumeria acutifolia* Poir, India. (*A monograph of the fungus genus Cercospora*, p. 154, 1953).

C. **puderii** Ben Davis (*Mycologia*, 30: 291, 1938). On leaves of *Rosa* sp., Patna, Bihar (**105**: 229).

C. **rejouae** Thirum. & Govindu. On leaves of *Rejoua dichotoma*, Koppa, Mysore (**274**: 48).

C. **rhynchosiae-minimae** Thirum. & Govindu. On leaves of *Rhynchosia minima* DC., Hebbal, Bangalore (**274**: 48).

C. **scopariae** Lacy & Thirum. On leaves of *Scoparia dulcis* L., Patna, Bihar (**280**: 127).

C. **solanacea** Sacc. & Berl. (**Sacc. IV**, 449). On leaves of *Solanum verbascifolium* L., Kallar, Madras State (**105**: 224).

C. **solani-tuberosi** Thirum. On leaves and stems of *Solanum tuberosum* L., Patna, Bihar (**273**: 96; **281**: 80).

C. **sorghi** Ell. & Ev. v. **cymbopogonis** Govindu & Thirum. On leaves of *Cymbopogon caesium* Stapf., Hebbal, Bangalore (**105**: 227).

[C. **sydowiana** Chupp nom nov. for *Cercospora woodfordiae* Sydow (1930) non Petch (1922), recorded in **BB**: 144 (Chupp, *A Monograph of the fungus genus Cercospora*, p. 363, 1953).]

C. **tabernaemontanae** H. & P. Sydow (**Sacc. XXV**, 896 as *Cercosporina tabernaemontanae* (Syd.) Sacc.). On leaves of *Tabernaemontana coronaria* Br., Patna, Bihar (**274**: 48 as *C. tabernaemontanae* Thirum. & Govindu.).

[C. **tabernaemontanae** Thirum. & Govindu. (**274**: 48) is a later homonym, and a synonym (fide Thirum. & Govindu, **277**: 348) of *C. tabernaemontanae* H. & P. Sydow.].

C. **trapae** Thirum. & Govindu. On leaves of *Trapa bispinosa* Roxb., Gulzaribagh, Patna, Bihar (**277**: 346).

C. **tremae** (Stevens & Solheim) Chupp (*Bothalia*, 4: 881, 1948). On leaves of *Trema orientalis* Bl., Patna, Bihar (**275**: 311), but see *C. tremae* Hansf. 1944 and *C. tremae* Sawada 1944.

C. **trichodesmae** Govindu & Thirum. On leaves of *Trichodesma zeylanica* Br., Savandurga, Mysore (**106**: 222).

C. **trichophila** Stevens (**Sacc. XXV**, 892). On *Solanum verbascifolium* L., Mysore (**104**: 27).

C. **tridacis-procumbentis** Govindu & Thirum. On leaves of *Tridax procumbens* L., Hebbal, Bangalore (**274**: 49; **104**: 27).

C. **ugandensis** Hansf. (*Proc. Linn. Soc. Lond.*, 1942-43, p. 59, 1943). On leaves of *Mariscus* sp., Kallar, Madras State (**105**: 225).

C. **unamonoi** Cast. (*Riv. Agric. subtrop. trop.*, 42: 27, 1948). On leaves of *Capsicum frutescens* L., Kallar, Madras State (**105**: 223).

C. **venezuelae** Chupp v. **indica** Govindu & Thirum. On leaves of *Solanum indicum* L., Hosamande, Nilgiris, Madras State (**106**: 223).

C. **volkameriae** Speg. (**Sacc. XXII**, 1424). On leaves of *Clerodendron* sp., Nandi Hills, Mysore (**105**: 222).

C. **wendlandiae** Ramakr. & Sund. On living leaves of *Wendlandia notoniana* Wall., Mannanthody, Malabar (**196**: 192).

C. **zizaniae** Thirum & Govindu. On leaves of *Zizania aquatica* L., Patna, Bihar (**274**: 49).

**CERCOSPORELLA** Sacc. (Sacc. IV, 218). Imp., Moniliales, Moniliaceae (E).

**C. acalyphae** Lacy & Thirum. On leaves of *Acalypha indica* L., Patna, Bihar (280: 126).

**C. endecaphyllae** Ramakr. & Sund. On living leaves of *Indigofera endecaphylla* Jacq., Kodambarai, Annamalais, Madras State (199: 147).

**CERCOSPORINA** Speg. = *Cercospora* fide Solheim (Sacc. XXII, 1432). Imp., Moniliales, Dematiaceae (E).

**C. imperatae** H. & P. Sydow (Sacc. XXV, 904). On living leaves of *Imperata arundinacea* Cyr., Aduthurai, Madras State (199: 147 as *C. imperatae* (Syd. H. & P.) Sawada).

**CHAETOMIUM** Kunze ex Fr. (Sacc. I, 220). Asco., Sphaeriales (A2).

**C. bostrychodes** Zopf (Sacc. I, 224). Isolated from black cotton soils, Udumalpet, Madras State (306: 109; 251: 209).

**C. brasiliense** Batista & Pontual (*Bol. Sec. Agrl. Ind. De Com. Pernambuco*, 15: 70, 1948). Isolated from rotten jute fabric, Calcutta, India (239: 787).

**C. funicolum** Cooke (Sacc. I, 226). Isolated from a cap, India (205: 61); on fibre,? Calcutta (24: 92).

**C. nigricolor** Ames (*Mycologia*, 42: 645, 1950). India.

**C. rufum** K. Ramakr. On moist straw, University Botany Laboratory campus, Madras (184: 118).

**C. trilaterale** Chivers (Sacc. XXIV, 842). Isolated from rice field soil, Vandalur, Chingleput Dt., Madras State (183: 65; 186: 112).

**CHLORIDIUM** Link (Sacc. IV, 320). Imp., Moniliales, Dematiaceae (A).

**C. indicum** C. V. Subram. On dead leaves of *Phoenix canariensis* Chabaud, Sim's Park, Coonoor, Nilgiris, Madras State (258: 286).

**C. schulzerii** Link (Sacc. IV, 322). On dead stems, Government House Estate, Madras (257: 40).

**CHYTRIDIUM** Braun (Sacc. VII, 304). Phyco., Chytridiales, Chytridiaceae.

**C. lagenaria** Schenk (Sacc. XI, 250). On *Spirogyra* sp., in water, Lucknow, U.P. (70: 221, without authority).

**C. schenkii** (Dang.) Scherff. (*Arch. Protistenk.*, 54: 237, 1926; Sacc. VII, 288 as *Rhizidium schenkii* Dang.). On *Spirogyra* sp., in water, Lucknow, U.P. (70: 221, without authority).

**CINTRACTIA** Cornu (Sacc. VII, 480) Basidio., Ustilaginales, Ustilaginaceae.

[**C. carpophila** (Schum.) Liro v. **elynae** (Syd.) Savile (*Canad. J. Bot.*, 30: 419, 1952). Recorded in **RS**: 13 as *C. elynae* Sydow.]

**C. clintonii** Cif. (*Ann. mycol.* 26: 29, 1928). In ovaries of *Fimbristylis diphylla* Vahl. v. *annua* C. B. Clarke, Banaras, U.P. (173: 92).

[**C. cyperi** Clinton (Sacc. XVII, 480). *C. peribebuyensis* (Speg.) Speg. v. *major* Pavgi & Mundkur, recorded in **RS**: 14 is now considered a synonym of *C. cyperi* fide Mundkur & Thirum. (157: 42).]

**C. scleriae** (DC.) Ling (Sacc. VII, 466 as *Ustilago scleriae* (DC.) Tul.) On *Rhynchospora corymbosa* (L.) Britt., India, in Massee Herb. 5735 (132: 316).

**CIRCINELLA** van Tiegh. & Le Monn. (Sacc. VII, 215). Phyco., Mucorales, Mucoraceae.

[**C. muscae** (Sorokine) Berl. & de Toni (Sacc. VII, 216) is the correct name for *C. spinosa* v Tiegh. & Le Monnier recorded in **M**: 10, fide Hesseltine and Fennel (112: 201-203).]

**CLADOSPORIUM** Link ex Fr. (Sacc. IV, 350). Imp., Moniliales, Dematiaceae (B).

**C. cladosporioides** (Fres.) de Vries (Contribution to the knowledge of the genus *Cladosporium* Link ex Fr., p. 57, 1952; Sacc. IV, 310, as *Hormodendrum cladosporioides* (Fres.) Sacc.). Isolated from soil, Sagar, M.P. (221: 274 as *Hormodendrum cladosporioides*).

**C. epiphyllum** (Pers.) Mart. (Sacc. IV, 360). Isolated from paddy soil, Gauhati, Assam (32: 308, without authority).

**CLASTEROSPORIUM** Schw. (Sacc. IV, 382). Imp., Moniliales, Dematiaceae (C).

**C. mori** Sydow (Sacc. XVI, 1060). On *Morus alba* Linn., University Botanical Gardens, Allahabad, U.P. (214: 207, without authority)

**CLAVICEPS** Tul. (Sacc. II, 564). Asco., Hypocreales (E).

**C. cynodonti** Langdon. On *Cynodon dactylon* Pers., India (126: 39-40).

**C. microcephala** (Wallr.) Tul. (Sacc. II, 565). In spikelets of *Echinochloa crus-galli* Beauv., Netrahat, Bihar (281: 81).

**CLYPEOLELLA** Hoehn. (Sacc. XXIV, 489). Asco., Hemisphaeriales.

[**C. camelliae** (Syd. & Butl.) Hansford (*Reinwardtia*, 3: 127, 1954). Recorded as *Asterina camelliae* Syd. & Butl., in BB: 15.]

**COCHLIOBOLUS** Drechsler (*Phytopathology*, 24: 973, 1934). Asco., Sphaeriales, (E).

**C. tritici** Dastur. Isolated from wheat kernels, Madhya Pradesh (71: 735).

**COELOMOMYCES** Keilin (Sacc. VII, 94). Phyco., Blastocladiales.

**C. anophelisica** Iyengar. In larvae of *Anopheles* spp., Sonarpur, Krishnagar and Meenglas, Bengal (115: 447).

**C. indiana** Iyengar. In larvae of *Anopheles* spp., Sonarpur, Dum Dum, Behala, areas around Calcutta, Krishnagar and Meenglas, Bengal (115: 446).

**COLEOSPORIUM** Lév., (Sacc. VII, 751) Basidio., Uredinales, Melampsoraceae.

**C. sidae** Sanwal. On living leaves of *Sida* spp., Mussoorie, (227: 385); Delhi (231: 305).

**COLLETOTRICHUM** Corda (Sacc. III, 735) Imp., Melanconiales (A1).

**C. alstoniae** (Sacc.) Singh. (Sacc. XXV, 538 as *Gloeosporium alstoniae* Sacc.). On living leaves of *Alstonia scholaris* R.Br., Kanpur, U.P. (Singh, R. S., in *Sci. & Cult.* 21: 534, 1956). Singh's new combination is not based on an examination of the type material of *Gloeosporium alstoniae* and is, therefore, of doubtful validity.

**C. capsici** (Sydow) Butler & Bisby f. **cyamopsicola** Desai & Prasad. On *Cyamopsis tetragonoloba* Taub., Anand, Bombay State (75: 56).

**C. crossandrae** Patel, Kamat & Pande. On leaves of *Crossandra infundibuliformis* Nees, Poona, Bombay State (167: 136).

**C. cylindricum** S. N. S. Srivastava. On leaves of *Pothos scandens* L., Poona, Bombay State (246: 244).

**C. dematium** (Pers. ex Fr.) Grove (*J. Bot.*, 56: 341, 1918; Sacc. III, 225 as *Vermicularia dematium* (Pers.) Fr.). On living leaves of *Lonicera hildebrandtiana* Collet & Hemel., Coonoor, Nilgiris, Madras State (Kandaswamy & Sundaram, *Sci. & Cult.* 21: 534, 1956).

**C. dracaenicola** Sacc. & Trotter (Sacc. XXII, 1205). On *Dracaena terminalis* W., University Botanical Garden, Allahabad, U.P. (214: 206).

**C. inamdarii** Lal. On leaves of *Carissa carandas* L., Banaras, U.P. (125: 58).

**C. lineola** Corda (Sacc. III, 736). On *Sorghum vulgare* Pers., Allahabad, U.P. (214: 206; 147: 247).

**COPRINUS** (Pers. ex Fr.) S. F. Gray (**Sacc. V**, 1078). Basidio., Agaricales, Agaricaceae, Melanosporeae.

**C. atramentarius** (Bull.) Fr. (**Sacc. V**, 1081). On the ground, Allahabad, U.P. (**214**: 205, without authority).

**C. disseminatus** (Pers. ex Fr.) S. F. Gray. On and around stumps, India (**127**: 777).

**C. stellatus** Buller (Bisby, Buller & Dearness: *The fungi of Manitoba*, p. 190, 1929). On dung, India (**127**: 762). Lange & Smith (**127**: 763) state: "It is highly probable that this is *Agaricus subtilis* Fries, but we deem it better not to revive this name".

**CORIOLUS** Quel. = *Polystictus* fide Saccardo (**Sacc. XII**, 134). Basidio., Agaricales, Polyporaceae.

[**C. occidentalis** (Klotsch) Imazeki (*Bull. Govt. For. Exp. Sta Tokyo*, **57**: 100, 1952). Recorded as *Polystictus occidentalis* Klotsch in **BB**: **123**.]

**CORYNESPORA** Gussow (**Sacc. XXII**, 1435) Imp., Moniliales, Dematiaceae (C).

**C. cassiicola** (Berk. & Curt.) Wei (*Mycol. Pap.*, **34**: 5, 1950; **Sacc. IV**, 419 as *Helminthosporium cassiaecolum* B. & C.) On leaves of *Croton sparsiflorus*, Patna, Bihar (**280**: 125); on dead stems of *Cassia* sp., and dead stems, Kolathuraar, Chingleput Dt., on rotting leaves of *Carica papaya* L., Chingavanam, T. C State; on dead stems, Ernakulam, T. C. State, (**248**: 52).

**CRYPTOCOCCUS** Kutzing em Vuill. (**Sacc. VIII**, 917, under *Saccharomyces*) Imp., Moniliales, Pseudosaccharomycetaceae.

**C. laurentii** (Kufferath) Skinner (**139**: 381). Isolated from sea water, Bombay (**31**: 26, without authority).

**CRYPTODERMA** Imazeki (*Bull. Tokyo Sci. Mus.* **6**: 106, 1943) is a segregate from *Fomes*. Basidio., Agaricales, Polyporaceae.

**C. dependens** (Murr.) Imazeki (*Bull. Tokyo Sci. Mus.* **6**: 107, 1943; **Sacc. XXI**, 292 as *Fomes dependens* (Murr.) Sacc.). On trees, Naini Tal, U.P. (**29**: 25, as *Fomes dependens* without authority).

**CRYPTOSTICTIS** Fuck. (**Sacc. III**, 443). Imp., Melanconiales (C2).

**C. grevilleae** (Loos) C. V. Subram. & K. Ramakr. (**266**: 231). On living leaves of *Grevillea robusta* A. Cunn., Nilgiris, Madras State (**304**: 570 as *Amphichaeta grevilleae* Loos).

**CUNNINGHAMELLA** Matr. (**Sacc. XVII**, 508). Phyco., Mucorales, Choanephoraceae.

**C. bertholletiae** Stadel (**Sacc. XXIV**, 13). Isolated from soil, New Delhi (**73**: 149, without authority), Allahabad, U.P. (**178**: 120, without authority) Vandalur, Madras (**183**: 58; **186**: 112), Sagar, M.P. (**221**: 272).

**CURVULARIA** Boedijn (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 123, 1933). Imp., Moniliales, Dematiaceae (C).

**C. andropogonis** (Zimm.)) Boed. (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 128, 1933; **Sacc. XVIII**, 594, as *Napicladium andropogonis* Zimm). On dead leaves of *Dichanthium annulatum* Stapf., Agri-Horticultural Society's Gardens, Madras (**253**: 30).

**C. falcata** (Tehon) Boed. (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 130, 1933; **Sacc. XXV**, 813 as *Acrothecium falcatum* Tehon.). On dead palm leaf, University Botany Laboratory campus, Madras (**253**: 37).

**C. geniculata** (Tracy & Earle) Boed. (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 129, 1933; **Sacc. XIV**, 1087 as *Helminthosporium geniculatum* Tracy & Earle). On rice grains, Hyderabad, Dn., (**151**: 123, without authority; **203**: 268).

**C. inaequalis** (Shear) Boed., (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 129, 1933; **Sacc. XXII**, 1391 as *Helminthosporium inaequale* Shear). On dead leaves of palm (? *Cocos nucifera* L.), Velacheri, Chingleput Dt., Madras State (**253**: 36).

**C. indica** C. V. Subram. On dead culms of *Scirpus* sp., Poonamallee, Chingleput Dt., Madras State (**253**: 34).

**C. maculans** (Bancroft) Boed. (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 125, 1933). On dead culms of *Scirpus* sp., Poonamalle, Chingleput Dt., Madras State and leaf sheath of *Musa paradisiaca* L., Athur Farm, Chingleput Dt., Madras State (**253**: 27); isolated from rice field soil, Vandalur, Chingleput Dt., Madras State (**183**: 74; **186**: 112).

**C. pallescens** Boed. (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 127, 1933). On dead palm leaf, University Botany Laboratory campus, Madras (**253**: 29); isolated from dryland soil, Vandalur, Chingleput Dt., Madras State (**183**: 74; **186**: 112); on rice grains, Hyderabad, Dn., (**203**: 268); parasitic on *Aecidium urgineae* Ramachar, Hyderabad, Dn., (**182**: 216).

**C. palmarum** C. V. Subram. On dead leaves of *Cocos nucifera* L., Mylapore, Madras (**253**: 38).

**C. spicifera** (Bain.) Boed. (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 127, 1933; **Sacc. XXII**, 1399 as *Brachycladium spiciferum* Bain.). On rice grains, Hyderabad, Dn., (**203**: 268). *Helminthosporium tetramera* McKinney recorded in **M**: 35 is probably a synonym of *C. spicifera* fide Hynes (*Proc. Roy. Soc. N.S.W.*, **70**: 378-91, 1937). See under *Curvularia tetramera.*

[**C. tetramera** (McKinney) Gilman (**98**: 303). Recorded as *Helminthosporium tetramera* McKinney in **M**: 35. This does not appear to be a *Curvularia* and is better retained under *Helminthosporium.*]

**C. trifolii** (Kauffm.) Boed. (*Bull. Jard. bot. Buitenz.*, Ser. III, **13**: 128, 1933; **Sacc. XXV**, 835 as *Brachysporium trifolii* Kauffm.). On dead culms of *Scirpus* sp., Poonamalle, Chingleput Dt., Madras State (**253**: 31).

**C. uncinata** Bugnicourt (*Rev. gen. Bot.*, **57**: 73, 1950). On dead culms of *Scirpus* sp., Poonamalle, Chingleput Dt., Madras State (**253**: 38).

**CYSTOPSORA** Butler (**Sacc. XXI**, 607). Basidio., Uredinales, Pucciniaceae.

**C. antidesmatis** Ramakr. & Sund. On living leaves of *Antidesma diandrum* Roth and *A. menasu* Miq., Mangalore, S. Kanara, Madras State (**194**: 26).

**DAEDALEA** Pers. ex Fr. (**Sacc. VI**, 370). Basidio. Agaricales, Polyporaceae.

**D. schomburgkii** Berk. (**Sacc. VI**, 376). On *Shorea robusta* Gaertn., India (**14**: 20).

**D. subsulcata** Berk. & Br. (**Sacc. VI**, 372). On logs and stumps, Darjeeling and Tipperah Dts., Bengal (**206**: 96).

**DAEDALEOPSIS** Schroet. = *Daedalea* fide Killermann. Basidio., Agaricales, Polyporaceae

[**D. tenuis** (Hook. ex Fr.) Imazeki (*Bull. Tokyo Sci. Mus.*, **6**: 78; 1943). Recorded as *Hexagonia tenuis* Hook., in **BB**: 100].

**DASTURELLA** Mundkur & Kheswalla (*Mycologia*, **35**: 202, 1943). Basidio., Uredinales.

**D. boswelliae** Patel, Payak & Kulkarni. On leaves of *Boswellia serrata* Roxb., Poona, Bombay State (**168**: 72).

**D. grewiae** (Pat. & Har.) Thirum. (*Bull. Torrey bot. Cl.* **73**: 348, 1946; Cummins, *Bull. Torrey bot. Cl.*, **72**: 206, 1945 as *Phakopsora grewiae* (Pat. &

Har.) Cummins; **Sacc. XVI**, 351 as *Uredo grewiae* P. & H.). On *Grewia asiatica* Mast., Poona, Bombay State (**174**: 343, uredia only); on living leaves of *Grewia aspera* Roxb., Walayar, Malabar, Madras State (**202**: 58 as *Phakopsora grewiae*).

**DEBARYOMYCES** Lodder & van Rij (**139**: 277-79). Asco., Endomycetales.

**D. hansenii** (Zopf) Lodder & van Rij (**139**: 280; **Sacc. VIII**, 918 as *Saccharomyces hansenii* Zopf). Isolated from sea water, Bombay (**30**: 13; **31**: 26, without authority).

**D. kloeckeri** Guillierm. & Peju (**139**: 285). Isolated from sea water, Bombay (**30**: 13, **31**: 26, without authority).

**D. nicotianae** Giovannozzi (**139**: 294). Isolated from sea water, Bombay (**30**: 13, **31**: 26, without authority).

**D. subglobosus** (Zach) Lodder & van Rij (**139**: 290). Isolated from sea water, Bombay (**30**: 13, **31**: 26, without authority).

**DEMATIUM** Pers. ex. Fr., (**Sacc. IV**, 308). Imp., Moniliales, Dematiaceae (A).

**D. mansoni** (Castellani) Dodge. On man, India (**85**: 678).

**DENDROPHOMA** Sacc. (**Sacc. III**, 178). Imp., Sphaeropsidales, Sphaerioidaceae (A).

**D. obscurans** (Ell. & Ev.) Anderson (*Bull. Illinois agric. Exp. Sta.*, **229**: 135, 1920; **Sacc. XI**, 489 as *Phoma obscurans* E. & E.). On strawberry, Kumaon, U.P., (**38**: 78).

**DENDRYPHION** Wallr. (**Sacc. IV**, 487 as *Dendryphium*). Imp., Moniliales, Dematiaceae (C).

**D. digitatum** C. V. Subram. On dead stems, Coonoor, and Government Gardens, Ootacamund, Nilgiris, Madras State (**258**: 289).

[**D. interseminatum** (Berk. & Rav.) Hughes (*Canad. J. Bot.*, 31: 638; 1953). Recorded as *Heterosporium interseminatum* (Berk. & Rav.) Atk., in **RS**: 23.]

**D. laxum** Berk. & Br. (**Sacc. IV**, 490). On dead stem, Doddabetta, Nilgiris, Madras State (**252**: 98).

**DICOCCUM** Corda ex Fr. (**Sacc. IV**, 342). Imp., Moniliales, Dematiaceae (B).

**D. asperum** (Corda) Sacc. (**Sacc. IV**, 342). In ponds, Gauhati, Assam (**32**: 310, without authority).

**DICTYOARTHRINIUM** Hughes (*Mycol. Pap.* 48: 29, 1952). Imp., Moniliales, Dematiaceae (D).

**D. sacchari** (Stevenson apud Johnston & Stevenson) Damon (*Bull. Torrey bot. Cl.*, **80**: 164, 1953; **Sacc. XXV**, 863 as *Tetracoccosporium sacchari* Stevenson apud Johnston and Stevenson). On dead leaves of *Cocos nucifera* L., leaf sheath of *Musa paradisiaca* L., and *Ixora* (?) sp., Ernakulam, T. C. State; on grass culms, University Botany Laboratory garden, Madras (**249**: 160 as *Dictyoarthrinium quadratum* Hughes).

**DICTYOSPORIUM** Corda (**Sacc. IV**, 513). Imp., Moniliales, Dematiaceae (D).

**D. prolificum** Damon (*Lloydia*, 15: 119, 1952). On dead stem of *Lantana* sp., Oothu, Kodaikanal Hills, Madras State (**252**: 100).

**DIDYMOCHORA** Hoehn. (**Sacc. XXV**, 514). Imp., Sphaeropsidales, Leptostromaceae (B).

[**D. cedrelae** (Ramakr. T. S. & K.) C. V. Subram. & K. Ramakr. (**265**: 226). Recorded as *Discella cedrelae* Ramakr. T. S. & K. in **RS**: 18.]

**DIDYMOSPHAERIA** Fuck. (**Sacc. I**, 701). Asco., Sphaeriales (B2).

**D. bambusicola** Hoehn. (**Sacc. XXII**, 175). On dead ligule of ? *Bambusa* sp., Agri-Horticultural Society's Garden, Madras (**187**: 253).

**D. jambolana** Ramakr., Sriniv. & Sund. On leaves of *Syzigium jambolanum* DC., Coimbatore, Madras State (193: 84).

**DIMERIUM** Sacc. & Sydow (Sacc. XVII, 537). A *nomen confusum* fide Toro. Asco., Sphaeriales, (B2).

**D. piceum** (Berk. & Curt.) Theiss. (*Ann. mycol.*, 10: 5, 1912). Parasitic on the colonies of *Meliola tenella* Pat., Nandi Hills, Mysore (280: 124).

**DIPLODIA** Fr. (Sacc. III, 329). Imp., Sphaeropsidales, Sphaerioidaceae (B2).

**D. natalensis** Pole-Evans (Sacc. XXII, 992). On fruits of *Lagenaria vulgaris* Ser., Hyderabad, Dn. (76: 126, without authority); on fruits of *Myristica fragrans* Hoult., Burliar, Nilgiris, Madras State (191: 13, without authority).

**DISCOMYCETELLA** Sanwal (*Sydowia*, 7: 200, 1953). Asco., Pezizales, (A1).

**D. aquatica** Sanwal. On submerged rotten wood, in running water, River Ganga, Lachman Jhoola, Hardwar (230: 200).

**EIDAMELLA** Matr. & Dassonville (Sacc. XVI, 805), Asco., Eurotiales, Gymnoascaceae.

**E. actoni** Datta. On dead dog, India (*Indian vet. J.*, 8, 1932).

**ELSINOE** Racib. (Sacc. XVI, 804) Asco., Myriangiales, Myriangiaceae.

**E. cullenii** Ramakr. & Sund. On living leaves of *Cullenia excelsa* W., Kadamparai, Anamalais, Coimbatore Dt., Madras State (199: 141).

**EMERICELLA** Berk. & Br. (Sacc. VII, 154 as *Emericella* Berk.) Asco., Eurotiales.

[**E. nidulans** (Eidam) Vuill. (*C. R. Acad. Sci. Paris*, 184: 137, 1927) is the correct name (fide Benjamin, 27: 679) for *Aspergillus nidulans* (Eidam) Wint., recorded in **BB**: 140.]

[**E. rugulosa** (Thom & Raper) Benjamin (27: 680). Recorded as *Aspergillus rugulosus* Thom & Raper in **RS**: 7.]

[**E. variecolor** Berk. & Br. is the correct name (fide Benjamin, 27: 678) for *Aspergillus variecolor* (Berk. & Br.) Thom & Raper, recorded in **RS**: 7.]

**ENDODOTHELLA** Theissen & Sydow (Sacc. XXIV, 613), possibly = *Placostroma* Theiss. & Sydow. Asco., Dothideales, Phyllachoraceae.

**E. kanarensis** Ramakr. & Sund. On living leaflets of *Albizzia odoratissima* Benth., S. Kanara, Madras State (189: 111).

**ENDOMYCES** Riess (Sacc. VIII, 821) Asco., Endomycetales, Endomycetaceae.

**E. anacardii** Froilano de Mello. On "Acajousaft" on fruit of *Anacardium occidentale* L., Portuguese India. (*C. R. Soc. Biol.*, 84: 997, 1920).

**ENDOPHYLLUM** Lév., (Sacc. VII, 767) Basidio., Uredinales, Pucciniaceae.

**E. elaeagni-latifoliae** (Petch) Gokhale, Thirum. & Patel (Sacc. XXI, 778 & M: 20 as *Aecidium elaeagni-latifoliae* Petch). On *Elaeagnus latifolia* L., Mahableshwar, Bombay State (102: 126).

**E. spilanthes** Thirum. & Govindu. On leaves of *Spilanthes acmella* L., Hebbal, Bangalore (276: 390). See also *Aecidium spilanthes.*

**ENGLERULA** P. Henn. (Sacc. XVII, 529) Asco., Erysiphales, Englerulaceae.

**E. macarangae** P. Henn. (Sacc. XVII, 529). On leaves of *Macaranga* sp., Kemmangandi, Mysore (280: 124).

**ENTOMOPHTHORA** Fres. (Sacc. VII, 282) Phyco., Entomophthorales, Entomophthoraceae.

**E. brahminae** Bose & Mehta. On *Brahmina* sp., (beetle), Govt. Gardens, Chaubattia, Almora Dt., U.P. (40: 55).

**ENTYLOMA** de Bary (Sacc. VII, 487) Basidio., Ustilaginales, Tilletiaceae.

**E. globigena** Thirum. & Safee. In leaves of *Blumea* sp., Coorg (289: 443).

**E. nymphaeae** (Cunn.) Setchell v. **macrospora** Thirum., Pavgi & Safee. On leaves of *Nymphaea* sp., Banaras, U.P. (173: 91).

**EPICOCCUM** Link ex Wallr. (Sacc. IV, 736) Imp., Moniliales, Tuberculariaceae (D2).

**E. granulatum** Penzig (Sacc. IV, 738). In the wood of living *Aquillaria agallocha* Roxb., Gauhati, Assam (33: 240), Shillong, Borpathar, Assam (32: 309).

**EPIDERMOPHYTON** Sabour. (85: 477; 60: 258). Imp., Moniliales, Dermatophytes.

**E. floccosum** (Harz) Langeron & Miloch. (60: 260; 85: 481). On man, Calcutta (2: 420 as *Epidermophyton inguinale*, without authority; 93: 95, 96: 216, 97: 273 as *E. floccosum*, without authority); on man, India (90: 76, 95: 74, without authority).

**ERIOMYCOPSIS** Speg. (Sacc. XXII, 1328), Imp., Moniliales, Moniliaceae (C).

**E. bosquieae** Hansf. (*Bothalia*, 4: 464, 1942) Parasitic on colonies of *Meliola memecyli* Sydow on *Memecylon edule* Roxb., Bannerghatta, Bangalore (28: 124).

**E. meliolae** Hansf. (*Bothalia*, 4: 404, 1942). Parasitic on colonies of *Meliola tenella* Pat., Nandi Hills, Mysore (280: 124).

**ERYSIPHE** Hedw. f. ex. Fr. (Sacc. I, 15). Asco., Erysiphales, Erysiphaceae.

[**E. communis** Wallr. ex Fr. (Sacc. I, 18). Recorded as *E. cichoracearum* DC in BB: 22; but according to the International Rules as amended in 1950 the correct name should be *E. communis* fide Cooke (61: 574).] For correct citation of authority of other spp. of Erysiphaceae previously recorded from India, please refer Cooke (61).

**EUROTIUM** Link ex Fr., (Sacc. I, 25) Asco., Eurotiales, Eurotiaceae.

[**E. amstelodami** Mangin is the correct name for *Aspergillus amstelodami* (Mangin) Thom & Church recorded in RS: 7, fide Benjamin (27: 677).]

[**E. repens** de Bary is the correct name (fide Benjamin, 27: 674) for *Aspergillus repens* (Corda) de Bary recorded in BB: 140.]

**EXCIPULARIA** Sacc. em. Hoehnel (Sacc. XVIII, 688), Imp., Moniliales, Tuberculariaceae (C2).

**E. narsapurensis** C. V. Subram. On rotten wood, Narsapur, Hyderabad-Dn. (260: 56).

**EXOSPORIUM** Link ex Wallr. (Sacc. IV, 755), Imp., Moniliales, Tuberculariaceae (C2).

[**E. arecae** (Berk. & Br.). Petch (*Ann. Roy. bot. Gdns Peradeniya*, 10: 173-74, 1927). Recorded as *Brachysporium arecae* (B. & Br.) Sacc. in M: 31. See also 198: 64 and 260: 56.]

**E. coonoorense** C. V. Subram. On dead stem, Sim's Park, Coonoor, Nilgiris, Madras State (260: 60).

**E. fici** Payak & Thirum. (*nomen nudum*, no diagnosis). On *Ficus bengalensis* L., Poona, Bombay State (174: 343).

**FABRAEA** Sacc. (Sacc. VIII, 735). Asco., Helotiales.

**F. earliana** (Ell. & Ev.) Seaver (*N. Amer. Cup Fungi, Inoperculate*, p. 190, 1951; Sacc. VIII, 328 as *Mollisia earliana* (E. & E.) Sacc.). On strawberry, Kumaon, U.P. (38: 78 as *Diplocarpon earliana* (E. & E.) Sacc.).

**FARYSIA** Racib. (Sacc. XXI, 527). Basidio., Ustilaginales, Ustilaginaceae.

[**F. barberi** (Mundkur) Zundel (307: 40). Recorded as *Ustilago barberi* Mundkur in **RS**: 51. *Sorosporium barberi* (Mundkur) Ling (131: 44) is another name for the fungus.]

**FAVOLUS** Fr. (Sacc. VI, 390). Basidio, Agaricales, Polyporaceae.

[**F. grammocephalus** (Berk.) Imazeki (*Bull. Tokyo Sci. Mus.*, 6: 95, 1943). Recorded as *Polyporus grammocephalus* Berk., in **BB**: 116.]

**FAVOTRICHOPHYTON** Neveu-Lemaire (85: 512). Imp., Moniliales, Dermatophytes.

**F. discoides** (Sab.) Neveu-Lemaire (85: 514). On man, Calcutta, (44: 268 as *Trichophyton discoides,* without authority).

**FOMES** (Fr.) Kickx (Sacc. VI, 150 as *Fomes* Fr.) Basidio., Agaricales, Polyporaceae.

[**F. durus** (Jungh.) Cunningham (*Proc. Linn. Soc. N. S. W.*, 75: 224, 1950) Recorded as *Polyporus durus* Jungh in **M**: 27.]

**F. leucophaeus** Mont. (Sacc. VI, 173). On dead oak, Deoban, Chakrata, U.P. (18: 19).

**F. ostricoloris** Lloyd (Sacc. XXIII, 394 as *F. ostricolor*). On decaying logs of *Rhus wallichii* Hk. f., and decayed logs of *Corylus colurna* L., Kulu, Panjab (18: 20).

**F. ribis** (Schum.) Fr. (Sacc. VI, 184). On *Shorea robusta* Gaertn., India (14: 20).

**F. robustus** Karst. (Sacc. IX, 173). On living fir and trunks and stumps of spruce, Chakrata Division, U.P. and Bashahr Division, H.P., (19: 787).

**F. roseus** (Alb. & Schw.) Fr. (Sacc. VI, 189). On *Shorea robusta* Gaertn., India (14: 20); causing decay of coniferous timber like spruce, fir, deodar and blue-pine, Chakrata and Tehri Garhwal Division, U.P., Kulu, East Panjab, Bashahr Division, H.P. (19: 795).

**F. sanfordii** Lloyd (Sacc. XXIII, 399). On living *Lonicera*, sp., Khadrala, Bashahr, H.P., on living *Lonicera quinquelocularis* Hardw., Chakrata, U.P,. (18: 22).

**FOMITOPSIS** Karst. = *Fomes* fide Murrill, Basidio, Agaricales, Polyporaceae.

[**F. ochroleuca** (Berk.) Imazeki (*Bull. Tokyo Sci., Mus.*, 6: 92,, 1943). Recorded as *Polyporus ochroleucus* Berk., in **BB**: 117.]

[**F. rhodophaea** (Lév.) Imazeki (*Bull. Tokyo Sci. Mus.*, 6: 92, 1943). Recorded as *Polyporus rhodophaeus* Lév. in **BB**: 118.]

[**F. zonalis** (Berk.) Imazeki (*Bull. Tokyo Sci. Mus.*, 6: 92, 1943). Recorded as *Polyporus zonalis* Berk. in **BB**: 120.]

**FUSARIUM** Link ex Fr. (Sacc. IV, 694). Imp., Moniliales, Tuberculariaceae (C1).

**F. conglutinans** Wr. v. **citrinum** Wr. (305: 407). On *Cyamopsis tetragonoloba* Taub., Coimbatore (255: 35).

**F. dimerum** Penzig (Sacc. IV, 704). In soil, Gauhati, Assam (32: 309); isolated from cultivated soil, Coimbatore and Tirunelveli Dts., Madras State (301: 131).

**F. equiseti** (Corda) Sacc. v. **bullatum** (Sherb.) Wr. (305: 331; Sacc. XXV, 973 as *F. bullatum* Sherb.). On *Solanum melongena* L. and *Lycopersicon esculentum* Mill., Coimbatore (255: 29).

**F. nivale** (Fr.) Ces. (Sacc. X, 726, as *Fusarium nivale* Ces., 305: 317). Isolated from soil, Sagar, M.P., (221: 272).

**F. orthoceras** App. & Wr. (Sacc. XXII, 1477). Isolated from paddy soil, Gauhati, Assam (32: 309); on *Cicer arietinum* L., Madras (255: 36).

**F. orthoceras** App. & Wr. v. **lentis** Vasudeva & Sriniv. On *Lens esculenta*, Delhi (296: 28).

**F. oxysporum** Schlecht. f. **niveum** (E. F. Sm.) Snyder & Hansen (*Amer J. Bot.* 27: 66, 1940; **Sacc. XXII**, 1478 as *F. niveum* E. F. Sm.). Causing wilt of *Citrullus vulgaris* Schrad., Dorli near Kalyan, Bombay State (35: 310).

**F. oxysporum** Schlecht. f. **pisi** (Linford) Snyder & Hansen (*Amer J. Bot.* 27: 66, 1940), causing wilt of *Pisum sativum* L., Wai and Mahableshwar, Bombay State (35: 310).

**F. oxysporum** Schlecht. f. **psidii** Prasad, Mehta & Lal. On *Psidium guajava* L., U.P., (179: 753).

**F. oxysporum** Schlecht. f. **tracheiphilum** (E. F. Sm.) Synder & Hansen (*Amer. J. Bot.*, 27: 66, 1940; 305: 413 as *F. bulbigenum* Cke. & Mass. v. *tracheiphilum* (E. F. Sm.) Wr.). Causing wilt disease of *Vigna sinensis* Hask., U.P. (235: 380).

**F. scirpi** Lamb. & Fautr. v. **caudatum** (Wr.) Wr. (305: 336; **Sacc. XXV**, 964 as *F. caudatum* Wr.). Isolated from black cotton soil, Udumalpet, Madras State (247: 568; 251: 220).

**F. scirpi** Lamb. & Fautr. v. **longipes** (Wr. & Rg.) Wr. (305: 337). On *Oryza sativa* L., Coimbatore (255: 32.).

**F. solani** (Mart.) App. & Wr. f. **albizziae** Bagchee. Causing pit canker disease of *Albizzia procera* Benth., Dehra Dun, U.P. (15: 246-51).

**F. solani** (Mart.) App. & Wr. f. **nicotianae** Prasad & Patel. On *Nicotiana tabacum* L., Anand, Bombay State (180: 18).

**F. sporotrichioides** Sherb. (**Sacc. XXV**, 978). Isolated from soil, Coimbatore and Tirunelveli Dts., Madras State (301: 131).

**F. tricinctum** (Corda) Sacc. (**Sacc. IV**, 700). Isolated from soil, Coimbatore and Tirunelveli Dts.. Madras State (301: 131).

**GEOTRICHUM** Link ex? Sacc. (**Sacc. IV**, 39). Imp., Moniliales, Moniliaceae (A).

**G. candidum** Link ex? Sacc. (**Sacc. IV**, 39). In ponds, Gauhati, Assam (32: 310 as *Gloeotrichum candidum*, without authority).

**GIBBERA** Fr. (**Sacc. I**, 599). Asco., Sphaeriales (B1).

[**G. ramakrishnanii** Arx (9: 85). Synonym *Achorella vaccinii* Ramakr. (recorded in **RS**: 5) non *Gibbera vaccinii* (Fr.) Fr.]

**GLENOSPORA** Berk. & Curt. (**Sacc. IV**, 298) nom. rej. = *Septobasidium*, (Tremellales).

**G. semoni** Chalmers & Archibald. (85: 794). On man, India (99: 19).

**GLIOCLADIOPSIS** Saksena (219: 662). Imp.. Moniliales, Moniliaceae (B).

**G. sagariensis** Saksena. Isolated from soil, Ghatera Forests, Sagar, M.P., (219: 663; 221: 283).

**GLIOCLADIUM** Corda (**Sacc. IV**, 84). Imp., Moniliales, Moniliaceae (A).

**G. deliquescens** Sopp. (**Sacc. XXV**, 686). India (205: 68, without substratum); isolated from soil, Sagar, M.P. (223: 78; 221: 272).

**G. roseum** Bain. (**Sacc. XXII**, 1280). Isolated from leaves and roots of coconut trees, T. C. State (130: 164, without authority); isolated from soil, Sagar, M.P. (221: 272). Pinkerton (*Ann. Mo. bot. Gdn.*, 23: 44, 1936) cites this as a synonym of *Clonostachys araucaria* var. *confusa* Pinker.

**GLOEOSPORIUM** Desm. & Mont. (**Sacc. III**, 699). Imp., Melanconiales, (A1).

**G. albo-rubrum** Petch (**Sacc. XXII**, 1186). On living leaves of *Hevea brasiliensis* M. Arg., T. C. State (**196: 193**).

**G. limetticolum** Claus. (**Sacc. XXV, 555**). Isolated from *Citrus aurantifolia* Allahabad, U.P., **268: 1**).

**G. morindae** Payak & Thirum. (*nomen nudum*, no diagnosis). On *Morinda tinctoria* Roxb., Poona, Bombay State (**174: 343**).

**G. psidii** Delacr., (**Sacc. XVIII**, 541). On stems, leaves and fruits of *Psidium guajava* L., Allahabad, U.P. (**267: 103, 268: 1**).

**G. spegazzinii** Sacc. (**Sacc. X**, 449). Isolated from *Citrus medica* Willd., Allahabad, U.P. (**268: 1** as *Gloeosporium citricolum* Speg.).

**GLOMERELLA** Schrenk & Spaulding (**Sacc. XXIV**, 77). Asco., Sphaeriales (A1).

**G. psidii** (Delacr.) Sheld. (**Sacc. XIX**, 780). In cultures from fungus on fruits of *Psidium guajava* L., Mysore (**279: 133**). *Gloeosporium pisidii* Delacr. is the conidial state of this fungus.

**G. tucumanensis** (Speg.) Arx & Mueller (**10: 195**; **Sacc. XIV**, 523 as *Physalospora tucumanensis* Speg.). On leaf lamina of *Saccharum officinarum* L., New Delhi (**53: 158, 50: 63** as *Physalospora tucumanensis*). *Colletotrichum falcatum* Went recorded in **BB: 153** is the conidial state of this fungus.

**GONAPODYA** Fischer (**Sacc. XIV**, 452). Phyco., Monoblepharidales.

**G. polymorpha** Thaxter (**Sacc. XIV**, 453; **240: 474**). On submerged fruits Lucknow, U.P. (**69: 168**).

**G. prolifera** (Cornu) Fischer (**Sacc. VII**, 277 as *Monoblepharis prolifera* Cornu; **Sacc. XIV**, 452 under *Gonapodya siliquaeformis*; **240: 472**). On submerged fruits. Lucknow, U.P. (**69: 168**).

**GRANDINIA** Fr. (**Sacc. VI**, 500) Basidio., Agaricales, Hydnaceae.

**G. farinacea** (Pers. ex Fr.). Bourd. & Galz. (**Sacc. VI**, 472 as *Hydnum farinaceum* Pers.; **42: 412**). On logs of *Shorea robusta* Gaertn., Mosabani mines timber yard, Singhbhum, Bihar (**206: 95**).

**GUEPINIA** Fr. (non Bastard) = *Dacryopinax*, Tremellales fide Martin, *Lloydia* **11**: 116, 1948. (**Sacc. VI**, 805).

**G. peziza** Tul. (**Sacc. VI**, 805). On dead branches, Imphal, Assam (**32: 306**).

**GUIGNARDIA** Viala & Ravaz (**Sacc. XXII**, 72) Asco., Sphaeriales (A1).

**G. bidwellii** (Ell.) Viala & Ravaz (**Sacc. I**, 441 as *Physalospora bidwellii* (Ell.) Sacc.). On fruits of *Vitis vinifera* L., Ganguvarpatti, Madura Dt., Madras State (**201: 189**). The record in **M: 13** is from Pakistan.

**G. rugosa** Ramakr., Sriniv., & Sund. On living leaves of *Rubus rugosa* Sm., Ootacamund, Nilgiris, Madras State (**193: 85**).

**HANSENIASPORA** Zikes (**Sacc. XXIV**, 1306). Asco., Endomycetales, Saccharomycetaceae.

**H. valbyensis** Kloecker (**139: 309**; **Sacc. XXIV**, 1307). On rotting fruits of *Averrhoa carambola* L., Mysore (**128: 559**).

**HELICOCERAS** Linder (*Ann. Mo. bot. Gdn.*, **18**: 2, 1931). Imp., Moniliales, Dematiaceae (F).

**H. celtidis** (Biv.-Bernh.) Linder (*Ann. Mo. bot. Gdn.*, **18**: 4, 1931; **Sacc. IV**, 267 as *Gyroceras celtidis* (Biv.-Bernh.) Mont. & Ces.). On leaves of *Celtis* sp., Nandi Hills, Mysore (**280: 125** as *Gyroceras celtidis*).

**H. longisporum** C. V. Subram. On living leaves of *Celtis serotina* Pl., Sim's Park, Coonoor, Nilgiris, Madras State (**260: 62**).

**HELICOMINA** Olive (*Mycologia*, **40**: 16, 1948). Imp., Moniliales, Dematiaceae (C).

**H. indica** C. V. Subram. On living leaves of leguminous plant, Castle Rock, Bombay State (**260**: 64).

**HELMINTHOSPORIUM** Link ex Fr. (**Sacc. IV**, 402)., Moniliales, Dematiaceae (C).

**H. capense** Thuemen (**Sacc. IV**, 469 as *Cercospora capensis* (Thuem.) Sacc.). Parasitic on colonies of *Meliola salaciae* Hansf., Balehonnur, Bangalore (**280**: 125).

**H. dorycarpum** Mont. (**Sacc. IV**, 406) Parasitic on colonies of *Meliola tenella* Pat., Nandi Hills, Mysore (**280**: 125).

**H. litsae** Chowdhury. On living leaves of *Litsaea polyantha* Juss., Gurjugunia, Assam (**56**: 86).

**H. microsorum** P. Henn. (**Sacc. XXV**, 821) Isolated from dryland soil, Vandalur, Chingleput Dt., Madras State (**183**: 75; **186**: 112).

**H. nodulosum** Berk. & Curt. v. **tritici** Patel, Kamat & Padhye. *On Triticum* spp., Baramati, Poona, Bombay State (**166**: 25).

**HEMILEIA** Berk. & Br. (**Sacc. VII**, 585) Basidio., Uredinales, Pucciniaceae.

**H. pavetticola** Maubl. & Roger (*Bull. Soc. mycol., Fr.*, **54**: 48-54, 1938). On *Pavetta indica* L., Mahableshwar, Bombay State (**165**: 64).

**HETEROCHAETE** Pat. (**Sacc. XI**, 144). Basidio., Tremellales, Tremellaceae.

[**H. delicata** (Kl. ex Berk.) Bres. (*Hedwigia*, **53**: 77, 1912) is the correct name for *Hydnum delicatum* Kl. ex Berk., recorded in **BB**: 101, fide Bodman (**36**: 213).]

**H. mussoriensis** Bodman. Mussorie, Panjab (**36**: 221).

**HEXAGONIA** Poll. (**Sacc. VI**, 356). Basidio., Agaricales, Polyporaceae.

**H. pulchella** Lév. (**Sacc. VI**, 362). Bengal (**208**: 19).

**HIRSCHIOPORUS** Donk. (*Mededeel Bot. Mus. Her. Rijks. Universit. Utrecht.*, No. 9, 168, 1933). Is based on *Polystictus abietinus* (Fr.) Cke. Basidio., Agaricales, Polyporaceae.

[**H. versatilis** (Berk.) Imazeki (*J. Jap. Bot.*, **20**: 288, 1945). Recorded as *Trametes versatilis* Berk. in **M**: 30.]

**HIRSUTELLA** Pat. (Sacc: **XI**, 140 under *Hymenomycetes*). Imp., Moniliales, Stilbaceae (1).

**H. abietina** (Hoehn.) Petch (**Sacc. XXII**, 1441 as *Isaria abietina* Hoehn.). On *Pyrilla pusana*, India (**176**: 62).

**H. nodulosa** Petch (*Trans. Brit. mycol. Soc.*, **9**: 261). On *Zeuzera coffeae*, India (**140**: 712).

**HOMOSTEGIA** Fuckel (**Sacc. II**, 649). Asco., Dothideales, Phyllachoraceae.

**H. derridis** Ramakr. & Sund. On living leaves of *Derris heyneana* Benth, Burliar, Nilgiris, Madras State (**197**: 27).

**H. symploci** Racib. (**Sacc. XXIV**, 628). On living leaves of *Symplocos spicata* Roxb., Pannaikadu, Pulneys, Madras State (**199**: 141).

**HYDNUM** L. ex. Fr. (**Sacc. VI**, 430). Basidio., Agaricales, Hydnaceae.

**H. imbricatum** Linn. (**Sacc. VI**, 430). On coniferous wood, Mawphlong, Assam, (**32**: 306).

**HYMENOCHAETE** Lév. (**Sacc. VI**, 588). Basidio., Agaricales, Thelephoraceae.

**H. rubiginosa** (Schrad.) Lév. (**Sacc. VI**, 589). On dead oak and *Quercus semecarpifolia* Sm., Chakrata, U.P., Daran and Bashahr, H.P. (**18**: 24), on *Shorea robusta* Gaertn., India (**14**: 19). The record in **BB**: 102 adds "Recorded as occurring in India, but no definite reference noted. No Indian specimens were found in the collections of Léveille at Paris."

**H. tabacina** (Sowerby) Lév. (**Sacc. VI**, 590). On *Thea sinensis* L., Jorhat, Assam (**32:** 307 without authority); on dead *Quercus incana* Roxb., Chaubattia, (Ranikhet), Molta, (Chakrata), U.P., on dead *Quercus semecarpifolia* Sm., Mundali, Chakrata, U.P. (**18:** 24).

**HYPODERMA** DC. em. de Not. (**Sacc. II**, 784). Asco., Phacidiales, Phacidiaceae.

**H. leschnaultiae** Ramakr. & Sund. On living leaves of *Lonicera leschnaultii* Wall., Ootacamund, Nilgiris, Madras State (**201:** 191).

**H. viburni** Ramakr., Sriniv. & Sund. On living leaves of *Viburnum erubescens* Wall., Ootacamund, Nilgiris, Madras State (**193:** 85).

**HYPODERMELLA** Tubeuf (**Sacc. XI**, 385). Asco., Phacidiales, Phacidiaceae.

**H. rhamni** K. Ramakr. On living leaves of *Rhamnus* sp., Pillar Rocks, Kodaikanal, Madras State (**187:** 253).

**HYPOXYLON** Bull. ex Fr. (**Sacc. I**, 352). Asco., Sphaeriales (A2).

**H. annulatum** (Schw.) Mont. (**Sacc. I**, 365). On *Shorea robusta* Gaertn., India (**14:** 19).

**INDIELLA** Brumpt (**85:** 685) = *Madurella* Brumpt, Imp., Moniliales, Dermatophytes.

**I. mansoni** Brumpt (**85:** 686). On man?, India (**99:** 18).

**INONOTUS** Karst. (**Sacc. XXI**: 243 states "*Inonotus* Karst. et Pat. est *Polyporus* Mich.") is a segregate from *Polyporus*. Basidio, Agaricales, Polyporaceae.

**I. nothofagi** Cunn. (*Bull. Dep. sci. industr. Res. N.Z.*, **78:** 1948). On dead oak, Hatoo-Baghi, Lower Bashahr, H.P. (**18:** 24).

[**I. patouillardii** (Rick) Imazeki (*Bull. Tokyo Sci. Mus.*, **6:** 105, 1943). Recorded as *Polyporus patouillardii* Rick in **BB:** 118.]

**IRPEX** Fr. (**Sacc. VI**, 482). Basidio, Agaricales, Hydnaceae or Polyporaceae.

**I. maximus** Mont. (**Sacc. VI**, 486). On logs, Calcutta (**206:** 94 as *Irpex maximus* (Brot.) Fr.).

**ISARIA** Pers. ex Fr. (**Sacc. IV**, 584). Imp., Moniliales, Stilbaceae (A1).

**I. meliolae** Hansf. (*Proc. Linn. Soc. Lond.*, **155:** 63, 1943). Parasitic on colonies of *Meliola cansjerae* Hansf. & Thirum., Nandi Hills, Mysore (**280:** 125).

**ISARIOPSIS** Fres. (**Sacc. IV**, 630). Imp., Moniliales, Stilbaceae (C2).

**I. griseola** Sacc. (**Sacc. IV**, 630), On leaves of *Phaseolus vulgaris* L., Nilgiris, Madras State (**243:** 20).

**JULELLA** Fabre (**Sacc. II**, 289). Asco., Sphaeriales, (D1).

**J. sarcostemmatis** K. Ramakr. On living stems of *Sarcostemma brevistigma* Wt., & Arn., Tambaram, Chingleput Dt., Madras State (**185:** 145).

**KLOECKERA** Janke (*Z. Bakt.*, Abt. II, **76:** 161, 1928) Imp., Moniliales, Pseudosaccharomycetaceae.

**K. apiculata** (Reiss em. Klock.) Janke (*Z. Bakt.*, Abt. II, **76:** 161, 1928; **139:** 596). From tan liquor, Bangalore (**66:** 175 as *Saccharomyces apiculatus*, without authority).

**KOORCHALOMA** C. V. Subram. (**254:** 124) Imp., Moniliales, Tuberculariaceae (A1).

**K. madreeya** C. V. Subram. On dead culms of *Oryza sativa* L., Poonamalle, Chingleput Dt., Madras State (254: 124).

**KORDYANA** Pat. (Sacc. XVI, 199 as *Kordyana* Racib.) Basidio., Agaricales, Exobasidiaceae.

**K. celebensis** Gäumann (*Ann. mycol.*, 20: 275, 1922). On leaves of *Commelina attenuata* Koen., Bapatla, Andhra State (242: 276).

**KUEHNEOLA** Magnus (Sacc. XXIII, 788) Basidio., Uredinales, Melampsoraceae.

**K. trichosanthes** (Petch) Ramkr. & Sund. (Sacc. XXIII, 925 as *Uredo trichosanthes* Petch). On leaves of *Trichosanthes palmata* Roxb., Kallar, Coimbatore Dt., Madras State (189: 114).

**KULKARNIELLA** Gokhale & Patel (100: 172) Basidio., Uredinales, Pucciniaceae. But see Thirum. & Kern (279: 106) who consider this a synonym of *Monosporidium* Barclay.

**K. pavettae** Gokhale & Patel. On leaves of *Pavetta tomentosa* Roxb., Mahableshwar, Bombay State (100: 172).

**LACELLINA** Sacc. (Sacc. XXV, 781) Imp., Moniliales, Dematiaceae (A).

**L. graminicola** (B. & Br.) Petch (*Ann. Roy. bot. Gdn Peradeniya*, 9: 171, 1924; Sacc. IV, 325, as *Mesobotrys graminicola* B. & Br.). On dead bamboo stem, and dead stem, Thanthipandal, Kambakkam, Chingleput Dt., Madras (249: 163).

**LACELLINOPSIS** C. V. Subram. (252: 103) Imp., Moniliales, Dematiaceae (A).

**L. levispora** C. V. Subram. On dead leaf of? Lauraceae, Mercara, Coorg State (256: 28).

**L. sacchari** C. V. Subram. On dead leaves of *Saccharum officinarum* L., Athur, Chingleput Dt., Madras State (252: 104).

**LAESTADIA** Auersw. non Kunth. (Sacc. I, 420) = *Plagiostoma* Fuck. fide Arx (*Antonie van Leeuwenhoek*, 17: 259-72, 1951), Asco., Sphaeriales (B1).

**L. alternantherae** Ramakr. & Sund. On living leaves of *Alternanthera sessilis* R. Br., Cinchona, Anamalais, Madras State (199: 142). This is not congeneric with the type species of *Laestadia*, viz., *L. alnea* (Fr.) Auers. = *Plagiostoma alnea* (Fr.) Arx. *L. alternantherae* has, therefore, to be classified elsewhere.

**LAGENIDIUM** Schenk (Sacc. VII, 278) Phyco., Lagenidiales.

**L. rabenhorstii** Zopf (Sacc. VII, 279). On *Spirogyra* sp., Lucknow, U.P., (118: 121).

**LASIOSPHAERIA** Ces. & de Not. (Sacc. II, 191). Asco., Sphaeriales (spore character not constant).

**L. caryophylli** Ramakr. & Sund. On living leaves of *Syzigium caryophllaeum* Gaertn., Kasargode taluk, S. Kanara, Madras State. (197: 27).

**LENTINUS** Fr. (Sacc. V, 571) Basidio., Agaricales, Agaricaceae.

**L. fasciatus** Berk. (Sacc. V, 574). On dead twigs of *Mangifera indica* L., and log of *Shorea robusta* Gaertn., Burdwan Dt. and Calcutta, Bengal, (206: 96).

**LENZITES** Fr. (Sacc. V, 571) Basidio, Agaricales, Polyporaceae.

**L. flaccida** (Bull.) Fr. (Sacc. V, 638). On *Shorea robusta* Gaertn., India (14: 20).

**L. palisoti** Fr. (Sacc. V, 650). On dead *Quercus* spp. Jagdeo Block, Ranikhet, W. Almora; Gager, Bhowali; Deoban, Mundali, Chakrata, all in U.P., (18: 26).

**L. trabea** (Pers.) Fr. (**Sacc. V**, 638). On dead wood?, Naini Tal, U.P., (**148:** 180 as *L. trabea* Pers.)

**LEPTOMITUS** Agardh (**Sacc. VII**, 265) Phyco., Leptomitales.

**L. lacteus** (Roth) Agardh (**Sacc. VII**, 265 as *L. lacteus* Agardh; **240:** 563). In ponds, Gauhati, Assam (**32:** 296 as *L. lacteus* Agardh).

**LEPTOSPHAERIA** Ces. & de Not. (**Sacc: II**, 13) Asco., Sphaeriales (C2).

**L. culmifraga** Ces. & de Not. (**Sacc. II**, 95). On *Oryza sativa* L., Kamrup, Assam (**32:** 299). The record in **BB:** 26 is from Pakistan.

**L. oryzina** Sacc. (**Sacc. XXIV**, 996). On dead lemma and palea of *Oryza sativa* L., Mathabhanga, Cooch-behar; Mamari, Burdwan; Chinsurah, W. Bengal (**46:** 69).

**L. salvinii** Catt. (**Sacc. II**, 62). On culms of *Oryza sativa* L., Kamrup and Sibsagar, Assam (**32:** 299, without authority).

**LEPTOTHYRIUM** Kunze ex Wallr. (**Sacc. III**, 626). Imp., Sphaeropsidales, Leptostromaceae (A1).

**L. theae** Petch (*Ann. Roy. bot. Gdns Peradeniya*, **9:** 325, 1925).. On green shoots of tea, Travancore (**303:** 22, without authority).

**LICHTHEIMIA** Vuill. (**Sacc. XIX**, 1122; **158:** 77) = *Absidia* van Tieghem fide Zycha. Phyco., Mucorales, Mucoraceae.

**L. regnieri** (Lucet & Costantin) Vuill. (*Bull. Soc. mycol. Fr.*, **19**, 1903; **158:** 78; **Sacc. XXI**, 817 as *Mucor regnieri* L. & C.). Isolated from a shoe, India (**205:** 70).

**LINOCARPON** Sydow (**Sacc. XXIV**, 1078) Asco., Sphaeriales (E).

**L. cariceti** (B. & Br.) Petrak (*Sydowia*, **6:** 387, 1952; **Sacc. II**, 349, as *Ophiobolus graminis* Sacc.). On *Oryza sativa* L., Kongpokpi, Imphal, Assam (**32:** 300 as *Ophiobolus graminis*, without authority). *Gaeumannomyces graminis* (Sacc.) Arx & Olivier (*Trans. Brit. mycol. Soc.*, **35:** 32, 1952) is another name for the same fungus.

**LOMAANTHA** C. V. Subram. (**256:** 31) Imp., Moniliales, Dematiaceae (C).

**L. pooga** C. V. Subram. On dead stem of *Areca catechu* L., Ernakulam, T. C. State (**256:** 32).

**LOMACHASHAKA** C. V. Subram. (**260:** 67) Imp., Moniliales, Tuberculariaceae (A1).

**L. kera** C. V. Subram. On dead leaves of *Cocos nucifera* L., University Botany Laboratory campus, Madras (**260:** 67).

**MACRAEA** C. V. Subram., see PRATHIGADA.

**M. crataevae**, see *Prathigada crataevae*.

**M. punjabensis**, see *Prathigada punjabensis*.

**MACROPHOMA** (Sacc.) Berl & Vogl.? (**Sacc. X**, 189) = *Botryodiplodia*. Imp., Sphaeropsidales, Sphaerioidaceae.

**M. boerhaaviae** Ramakr. & Sund. On living leaves of *Boerhaavia diffusa* L., Kallar, Coimbatore Dt., Madras State (**202:** 59).

**M. convolvulacearum** Lacy & Thirum. On leaves of *Convolvulus* sp., Kemmangandi, Mysore (**280:** 127).

**M. glochidii** Kandaswamy & Sund. On living leaves of *Glochidion ellipticum* W., Coonoor, Nilgiris, Madras State (*Sci. & Cult.* **21:** 533, 1956).

**M. glycosmidis** Ramakr. & Sund. On living leaves of *Glycosmis cochinchinensis* Pierre, Kallar, Madras State (**202:** 59).

**M. gordoniae** Ramakr. & Sund. On living leaves of *Gordonia obtusa* Wall., Coonoor, Nilgiris, Madras State (**202:** 61).

**M. morindae** Ramakr. & Sund. On living leaves of *Morinda tinctoria* Roxb., Coimbatore, Madras State (200: 22).

**M. pyrenacanthae** Ramakr. & Sund. On living leaves of *Pyrenacantha volubilis* Hk., Kallar, Madras State (200: 22).

**M. sapindi** Ramakr. & Sund. On living leaves of *Sapindus emarginatus* Vahl., Kallar, Madras State (202: 61).

**M. shoreae** Bagchee. On living stems of *Shorea robusta* Gaertn., Dehra Dun and Bahraich Divisions, U.P. and Mandla Division, M.P. (14: 17).

**M. theicola** Siemaszko (*Acta. Soc. Bot. Polon.* **1**: 6, 1923). On tea, Nilgiris (?). (303: 5, without authority).

**M. toddaliae** Ramakr. & Sund. On living leaves of *Toddalia asiatica* Lamk., Ootacamund, Madras State (196: 194).

**MACROSPORIUM** Fr. (Sacc. **IV**, 523), is a *nomen ambiguum.*

**M. commune** Rabh. (Sacc. **IV**, 524). Isolated from soil, Sagar, M.P. (223: 78, without authority).

**MALASSEZIA** Baillon (85: 358) Imp., Moniliales, Pseudosaccharomycetaceae.

**M. tropica** (Cast.) Schmitter (85: 369). On man, S. India (99: 186).

**MARASMIUS** Fr. (Sacc. **V**, 503). Basidio., Agaricales, Agaricaceae.

**M. campanella** Holterm. (Sacc. **XVI**, 60). On *Lagerstroemia speciosa* (L.) Pers., Calcutta (20: 118, 21: 298; 22: 618).

**M. cupressiformis** Berk. (Sacc. **V**, 554). On *Shorea robusta* Gaertn., India (14: 21).

**M. gordipes** Sacc. & Paol. (Sacc. **XI**, 35). On *Shorea robusta* Gaertn., India (14: 21).

**M. haematocephalus** Mont. (Sacc. **V**, 540). On fallen leaves and other decayed plant material, Calcutta and Tipperah Dts., Bengal (206: 96).

**MARGARITISPORA** Ingold (*Trans. Brit. mycol. Soc.*, **25**: 352, 1942). Imp., Moniliales, Moniliaceae (C).

**M. aquatica** Ingold (*Trans. Brit. mycol. Soc.*, **25**: 353, 1942). In ponds, Gauhati, Assam (32: 310, without authority).

**MARSSONINA** Magn. (Sacc. **XXV**, 590). Imp., Melanconiales (B1).

**M. fragariae** (Sacc.) Klebh. On living leaves of *Fragaria neilgherrensis* Schl., Ootacamund, Madras State (193: 93).

**MASSARINA** Sacc. (Sacc. **II**, 153). Asco., Sphaeriales (C1).

**M. sarcostemmatis** K. Ramakr. On living stems of *Sarcostemma brevistigma* Wt., & Arn., Tambaram, Chingleput Dt., Madras State (185: 147).

**MELANOMMA** Nits. ex Fuckel. (Sacc. **II**, 98) Asco., Sphaeriales, (C2).

**M. citricola** Sydow & Butl., (Sacc. **XXIV**, 1011). On *Citrus medica* L., Bornihat, Assam, (32: 300). The record in **BB**: 27 is from Pakistan.

**MELANOPSAMMA** Niessl. (Sacc. **I**, 675). Asco., Sphaeriales, (B1).

**M. indica** K. Ramakr. On dead twigs, Tirumalai Hills, Andhra State (187: 254)

**MELANOPSICHIUM** Beck (Sacc. **XVII**, 484). Basidio., Ustilaginales, Ustilaginaceae.

[**M. emodensis** (Berk.) Zundel (307: 46). Recorded in **BB**: 44 as *Farysia emodensis* (Berk.) Sydow and as *Liroa emodensis* (Berk.) Cif. in **M**: 17.]

[**M. nepalensis** (Liro) Zundel (307: 46). Recorded as *Ustilago nepalensis* Liro in **RS**: 51.]

**MELANOSPORA** Corda (Sacc. **II**, 461). Asco., Hypocreales, (A2).

**M. brevirostrata** C. Moreau (*Bull. Soc. mycol. Fr.* **61**: 53-60, 1945). Isolated from rhizosphere of crop plants, Madras (5: 98).

**M. zamiae** Corda (**Sacc. II**, 463). On dead culms and glumes of *Oryza sativa* L., Borpeta, Assam (32: 299). The record in BB: 27 is from Pakistan.

**MELANOTAENIUM** de Bary (**Sacc. VII**, 496). Basidio., Ustilaginales, Tilletiaceae.

**M. brachiariae** Viegas v. **arthraxonis** Thirum. & Pavgi. On leaves of *Arthraxon* sp., Parasanath, Bihar (287: 101).

**MELIOLA** Fr. (**Sacc. I**, 60). Asco., Erysiphales, Meliolaceae.

**M. falcatiseta** Speg. var. **khasiensis** Hansf. On leaves of *Ilex* sp., Khasia, India (110: 16).

**M. plectroniae** Hansf. On leaves of *Plectronia umbellata*, Matheran, Bombay State (110: 72-73).

**M. salaciae** Hansf. (*Proc. Linn. Soc. Lond.*, 1944-1945, 183, 1946). On *Salacia* sp., Balehonnur, Mysore (280: 125).

**M. tenella** Pat. (**Sacc. IX**, 413). On *Murraya exotica* Linn., Nandi Hills, Mysore (280: 124).

**MEMNONIELLA** Hoehn. (*Z. Bakt.* Abt. II, 60: 16, 1923). Imp., Moniliales, Dematiaceae (A).

**M. levispora** C. V. Subram. On dead stem, Thanthipandal, Chingleput Dt., Madras State (257: 40).

**MERULIUS** Haller ex Fr. (**Sacc. VI**, 411). Basidio., Agaricales, Polyporaceae.

**M. lacrymans** (Wulf) Fr. (**Sacc. VI**, 419 as *M. lacrymans* (Jacq.) Fr.). On dead wood and timber, Kulsi, Assam (32: 306 as *M. lacrymans* Schum.); on boards made of *Picea morinda* Link, Pulga (Kulu, Panjab), (17: 80).

**M. tremellosus** (Schrad.) Fr. (**Sacc. VI**, 411 as *M. tremellosus* Schrad). On dead *Quercus incana* Roxb., Mundali, Chakrata, U.P.; Kasol, Kulu, Panjab; on dead oak and *Quercus semecarpifolia* Sm., Bahali and Baghi, H.P. (18: 26).

**METASPHAERIA** Sacc. (**Sacc. II**, 156) Asco., Sphaeriales (C1).

**M. raimundoi** Rehm. (**Sacc. XXIV**, 954). On dead twigs of *Crossandra undulaefolia* Salisb., University Botany Laboratory campus, Madras (187: 255).

**MICROCYCLUS** Sacc. (**Sacc. XVII**, 844) Asco., Dothideales, Dothideaceae.

**M. phoebes** K. Ramakr. On fallen leaves of *Phoebe paniculata* Nees, Mercara, Coorg State (187: 255).

**MICROSPORON**, see MICROSPORUM.

**MICROSPORUM** Gruby (85: 537; **Sacc. IV**, 100 as a subgenus of *Sporotrichum* Link). Imp., Moniliales, Dermatophytes.

**M. audouini** Gruby (**Sacc. IV**, 101). On man, Calcutta (79: 51; 80: 541, 92: 382, 78: 195, without authority).

**MICROSTROMA** Niessl (**Sacc. IV**, 9). Imp., Melanconiales (A1). Sometimes placed near *Exobasidium*.

**M. delonicis** Ramakr., Sriniv. & Sund. On living leaves of *Delonix elata* Gamb., Bapatla, Andhra State (192: 94).

**MONOCILLIUM** Saksena (220: 9) Imp., Moniliales, Moniliaceae (A).

**M. indicum** Saksena. Isolated from grassland soil, Patharia village, near Sagar, M.P. (220: 9; 221: 280).

**MONOTOSPORA** Sacc. (**Sacc. IV**, 299), a later homonym of *Monotospora* Corda. Imp., Moniliales, Dematiaceae (A).

**M. brevis** (Gilm. & Abbott) Mason (*Mycol. Pap.* 3: 59, 1933). In ponds, Gauhati, Assam (32: 310, without authority).

**M. daleae** Mason (*Mycol. Pap.* 3: 50, 1933). In ponds, Gauhati, Assam (32: 310, without authority).

**MORCHELLA** Dill. ex Fr. (**Sacc. VIII**, 8) Asco., Pezizales, Helvellaceae.

**M. vulgaris** (Pers.) Boud. (**111**: 160) In woodlands and forest floor, Mawphlong & Nichugard, Assam (**32**: 298, without authority).

**MUCOR** Mich. ex Fr. (**Sacc. VII**, 190) Phyco., Mucorales, Mucoraceae.

**M. luteus** Linnemann (*Flora*, Jena, **30**: 195, 1936). Isolated from soil, Sagar, M.P. (**221**: 276).

**M. mucedo** L. (**Sacc. VII**, 191). Isolated from paddy soil, Assam (**32**: 297, without authority). The record in **M**: 10 is from Pakistan.

**MYCOSPHAERELLA** Johanson (**Sacc. IX**, 659) Asco., Sphaeriales (B1).

[**M. agapanthi-umbellati** Ramakr. & Sund. nom. nov. for *M. agapanthi* Ramakr. T. S. & K. (**RS**: 29) non *M. agapanthi* Lindau (**201**: 190).]

**M. asplenii** (Jaap) Thirum. & Govindu. On leaves of *Asplenium nidus* L., Central College botanical Garden, Bangalore, (**277**: 345). *Cercospora asplenii* Jaap, recorded in **RS**: 10, is the conidial stage of this fungus.

**M. elatostemmae** Thirum. & Govindu. On leaves of *Elatostemma* sp., Balehonnur, Mysore (**277**: 345).

[**M. malinverniana** (Catt.) Miyake (*J. Coll. Agric. Tokyo*, **2**: 267, 1910). Recorded in **BB**: 38 as *Sphaerella malinverniana* Catt.]

**M. meliosmae** Ramakr., Sriniv. & Sund. On living leaves of *Meliosma wightii* Planch., Ootacamund, Nilgiris, Madras State (**193**: 86).

**MYZOCYTIUM** Schenk (**Sacc. VII**, 279; **240**: 648). Phyco., Lagenidiales.

**M. proliferum** Schenk (**Sacc. VII**, 279; **240**: 649). Parasitic on *Spirogyra* sp., Lucknow, U.P. (**69**: 169).

**NARASIMHANIA** Thirum. & Pavgi (**286**: 390). Basidio., Ustilaginales, Tilletiaceae.

**N. alismatis** Pavgi & Thirum. On leaves of *Alisma* sp., Banaras, U.P. (**286**: 390); on leaves of *Alisma reniformis* D. Don, Ranchi Road, Bihar (**281**: 82).

**NECTRIA** Fr. (**Sacc. II**, 479) Asco., Hypocreales (B1).

[**N. gracilipes** (Tul.) Wr. (*Angew. Bot.*, **8**: 186, 1926). Recorded as *Sphaerostilbe gracilipes* Tul. in **BB**: 38.]

**N. ochroleuca** (Schw.) Berk. (**Sacc. II**. 509). On *Thea sinensis* L., Jorhat, Assam (**32**: 299, without authority).

**NEOBARCLAYA** Sacc. (**Sacc. XIV**, 46). Imp., Melanconiales. (B2).

**N. congesta** (Berk. & Br.) Petch (*Ann. Roy. bot. Gdn Peradeniya*, **9**: 165, 192; **Sacc. IV**, 786 as *Pestalozzia congesta* B. & Br.). On living leaves of *Syzigium jambolanum* DC., Coimbatore, Madras State (**193**: 94).

**NIGROSPORA** Zimm. (**Sacc. XVIII**, 571). Imp., Moniliales, Dematiaceae (A).

**N. oryzae** (Berk. & Br.)Petch (*J. Indian bot. Soc.*, **4**: 21-24, 1924; **Sacc. IV**, 293 as *Monotospora oryzae* B. & Br.). On *Oryza sativa* L., Madras, Sirpur, Hyderabad-Dn., Bengal (**162**: 179).

**N. sphaerica** (Sacc.) Mason (*Trans. Brit. mycol. Soc.* **12**: 158, 1927; **Sacc. IV**, 293 as *Trichosporium sphaericum* Sacc.). Isolated from soil, Sagar, M.P. (**221**: 283). The record in **BB**: 148 is from Burma.

**OEDOCEPHALUM** Preuss (**Sacc. IV**, 47). Imp., Moniliales, Moniliaceae (A).

**O. coprophilum** Kobayasi (*Nagaoa*, **1**: 8-9, 1952). Isolated from the rhizosphere of crop plants, Madras (**5**: 101).

**OIDIUM** Sacc. (**Sacc. IV**, 40). Imp., Moniliales, Moniliaceae (A).

**O. acalyphae** Chiddarwar. On leaves of *Acalypha indica* L., Poona (**49**: 46).

**O. acanthospermi** Chiddarwar. On leaves of *Acanthospermum hispidum* DC., Poona, Bombay State (**49**: 46).

**O. indicum** Kamat. On young leaves and shoots of *Carica papaya* L, Poona, Bombay State (**48**: 240, without Latin diagnosis).

**O. lagasceae** Chiddarwar. On leaves of *Lagascea mollis* Cav., Poona, Bombay State, (**49**: 47).

**OLPIDIOPSIS** Cornu (**Sacc. VII**, 299; **240**: 609). Phyco., Lagenidiales.

**O. achlyae** McLarty (*Bull. Torrey bot. Cl.*, 68: 62, 1941; **240**: 616). Parasitic on *Achlya* sp., Lucknow, U.P. (**69**: 169 as *O. achlyae*).

[**O. fusiformis** Cornu (**Sacc. VII**, 300). *O. minor* Fischer recorded in **BB**: 1 is a synonym of this species fide Sparrow (**240**: 615).]

**OOSPORA** Wallr. (**Sacc. IV**, 11). Imp. Moniliales, Moniliaceae (A).

**O. variabilis** (Lindner) Lindau (**Sacc. XVI**, 1025 as *Monilia variabilis* Lindner; see also **Sacc. XXV**, 644). Isolated from soil. Allahabad, U.P. (**216**: 76).

**PAATHRAMAYA** C. V. Subram. (**260**: 70). Imp., Moniliales, Stilbaceae (A2).

**P. sundara** C. V. Subram. On dead stem, Narsapur, Hyderabad-Dn., (**260**: 70).

**PAECILOMYCES** Bain. (**Sacc. XXII**, 1273 under *Penicillium;* **204**: 688). Imp., Moniliales, Moniliaceae (A).

**P. fusisporus** Saksena. Isolated from soil, Patharia Forest, near Sagar, M.P., (**218**: 187; **221**: 274).

**P. varioti** Bain. (**Sacc. XXII**, 1273 under *Penicillium varioti* (Bain.) Sacc.; **204**: 691). Isolated from wax paper, India (**205**: 72); on jute fibre and fabric, Calcutta (**25**: 285; **26**: 154; **34**: 190); on fibre, Calcutta (**24**: 92); isolated from soil, Allahabad, U.P., (**178**: 120, without authority; **215**: 35; **216**: 76), Calcutta (**37**: 251), Sagar, M.P. (**221**: 274); on dasooti, Calcutta (**7**: 421).

**PARASACCHAROMYCES** Beurmann & Goug. nom. rej. = *Candida*. Imp., Moniliales, Pseudosaccharomycetaceae.

**P. giganteus** F. de Mello (*C. R. Soc. Biol.*, 84: 997, 1920). On 'Acajousaft' on fruits of *Anacardium occidentale* L., Portuguese India.

**PATELLA** Weber ex Morgan (**Sacc. VIII**, 166 as *Lachnea* Fr.). Syn. *Lachnea* (Fr.) Gill., non L. Asco., Pezizales.

**P. gilva** (Boud.) Seaver (*N. Amer. Cup. Fungi*, Suppl. ed. 166, 1943; **Sacc. VIII**, 184 as *Lachnea gilva* Boud.). On damp wall, Naini Tal, Kumaon, U.P., and Mossy Falls, Mussorie, U.P. (**229**: 197).

**P. scutellata** (L.) Morgan (*J. Mycol.*, 8: 187, 1902; **Sacc. VIII**, 173 as *Lachnea scutellata* L.). On rotten wood and soil, on decayed *Rhododendron* (?) wood, Kalika, Kumaon, U.P., (**229**: 196).

**PATELLARIA** Fr. (**Sacc. VIII**, 786 gives *Patellaria* Wahl.). Asco., Helotiales.

**P. ricciophila** Seaver (*N. Amer. Cup. Fungi*, Suppl. 165, 1942). Epiphytic (?) on *Riccia* sp., and on soil, Naini Tal, Kumaon, U.P. (**229**: 197).

**PENICILLIUM** Link ex Fr. (**Sacc. IV**, 78). Imp., Moniliales, Moniliaceae (A).

**P. adametzi** Zaleski (**204**: 228). On jute fibre, Calcutta (**26**: 154).

**P. brefeldianum** Dodge (**204**: 141). On fibre, Calcutta (**24**: 92); isolated from soil, Calcutta (**37**: 251).

**P. camemberti** Thom (**Sacc. XXII**, 1268; **204**: 426). From tan liquor, Bangalore, (**66**: 175, without authority).

**P. chrysogenum** Thom (Sacc. XXII, 1266; 204: 359). In soil, Gauhati, Assam (32: 297, without authority).

**P. citrinum** Thom (Sacc. XXII, 1266; 204: 345). Isolated from atmosphere, Kanpur, U.P., (181: 36, without authority); on jute cloth, Calcutta (34: 190, without authority). Since no authority is cited by the authors, we take it that Thom's binomial is meant; but there is *P. citrinum* Sopp, a later homonym in Sacc. XXV, 666.

**P. claviforme** Bain. (Sacc. XVIII, 520; 204: 549). From tan liquor, Bangalore (66: 175, without authority).

**P. cyaneum** (Bain. & Sart.) Biourge (Sacc. XXV, 682 as *Citromyces cyaneus* B. & S.; 204: 244). On jute fibre, Calcutta (26: 154)

**P. expansum** Link (Sacc. IV, 78 under *P. glaucum* Link; 204: 512). On *Citrus chrysocarpa* Lush., Kalimpong, Bengal (208: 30); on fruits of *Citrus chrysocarpa* Lush., Bornihat, Assam (32: 297); causing soft-rot of pears, (*Pyrus communis* Linn.), Kanpur, U.P. (11: 153 as *P. expansum* Thom — such a binomial is not found in Raper & Thom, 204); the record in M: 36 is from Pakistan.

**P. frequentans** Westling (Sacc. XXV, 670; 204: 172). Isolated from soil, W. Bengal (142: 167, without authority).

**P. funiculosum** Thom (Sacc. XXII, 1268; 204: 616). Isolated from soil, Sagar, M.P. (221: 278).

**P. granulatum** Bainier (Sacc. XVIII, 520; 204: 544). In tan liquors, Bangalore (66: 175, without authority; 204: 547).

**P. implicatum** Biourge (204: 201). On fibre, Calcutta (26: 154; 24: 92); isolated from soil, Calcutta (37: 251).

**P. italicum** Wehmer (Sacc. XIV, 1047; 204: 526). On *Citrus chrysocarpa* Lush., Kalimpong, W. Bengal (208: 30), Gauhati, Assam (32: 297); in soil, Gauhati, Assam (32: 297).

**P. lilacinum** Thom (Sacc. XXII, 1268; 204: 285). Isolated from paddy soil, Chinsurah, W. Bengal (207: 29; 208: 30; 251: 221); isolated from soil, Sagar, M.P. (221: 272).

**P. nigricans** Bainier (204: 325 as *P. nigricans* (Bain.) Thom.). Isolated from soil, Sagar, M.P. (221: 272); W. Bengal (142: 167, without authority). As already indicated above, Raper and Thom (204: 325) cite the name as *P. nigricans* (Bain.) Thom, but it is not clear from their monograph what the basonym of Thom's new combination is. On p. 328 they refer to a culture labelled "*Penicillium nigricans*" (nomen nudum) received from the Bainier collection in Paris. If this binomial is accepted and validated by a description the correct citation should be *P. nigricans* Bain. apud Thom (1930, *The Manual of Penicillia*).

**P. purpurogenum** Stoll (Sacc. XVIII, 520; 204: 633). On fibre, Calcutta (24: 92); causing rice spoilage, Calcutta (141: 126, without authority).

**P. roseo-purpureum** Dierckx (Sacc. XVI, 1030; 204: 218). On fibre, Calcutta (24: 92).

**P. rubrum** Stoll (Sacc. XVIII, 520; 204: 637). Isolated from soil, Calcutta (37: 251).

"**P. sanguifluus** (Sopp) Biourge." Isolated from soil, Allahabad, U.P. (215: 33; 216: 76). *P. sanguifluus* (Sopp) Biourge is not mentioned by Raper and Thom (204). If, however, the authors mean *Citromyces sanguifluus* Sopp, this is considered by Raper and Thom (204: 220) as the same as *Penicillium roseo-purpureum* Dierckx.

**P. simplicissimum** (Oudem.) Thom (204: 304; Sacc. XVIII, 538 as *Spicaria simplicissima* Oudem.). Isolated from soil, Calcutta (37: 251).

**P. steckii** Zaleski (204: 350). Isolated from soil, W. Bengal (155: 221, without authority).

**P. tardum** Thom (204: 651). On jute fabric, Calcutta (26: 154; 34: 190, without authority).

**P. terrestre** Jensen (Sacc. XXV, 679; 204: 450). Isolated from paddy soil, Gauhati, Assam (32: 297). The record in M: 36 is from Pakistan.

**P. variabile** Sopp (Sacc. XXV, 671; 204: 642). Isolated from soil, Calcutta (37: 251), W. Bengal (155: 221, without authority); on fibre, Calcutta (26: 154; 24: 92); on jute cloth, Calcutta (34: 190, without authority).

**P. verruculosum** Peyronel (Sacc. XXV, 672; 204: 621). On jute cloth, Calcutta (34: 190, without authority).

**P. viridi-varians** Chaudhuri & Sachar (*Ann. mycol.*, 32: 98, 1934). Isolated from paddy soil, Chinsurah, W. Bengal (207: 29; 251: 221), Gauhati, Assam (32: 297). Raper & Thom (204: 347) suggest that this may possibly be *P. nalgiovensis* Laxa. The record in M: 36 is from Pakistan.

**PENIOPHORA** Cooke (Sacc. VI, 640). Basidio., Agaricales, Thelephoraceae.

**P. filamentosa** (Berk. & Curt.) Burt. (apud Coker, *J. Elisha Mitch. Sci. Soc.*, 36: 162, 1921; Sacc. VI, 619 as *Corticium filamentosum* Berk. & Curt.). On dead *Quercus dilatata*, Mundali, Chakrata, U.P. (18: 27).

**PERICONIA** Tode ex Schw. (Sacc. IV, 270). Imp., Moniliales, Dematiaceae (A).

**P. byssoides** Pers. ex Schw. (Sacc. IV, 271). On dead stem, Thirumalai Hills, Andhra State; Doddabetta, Nilgiris, Madras State; Vandalur, Chingleput Dt., Madras State; on dead stem of *Cassia* sp., Kolathurar, Chingleput Dt., of *Artemesia* sp., Ootacamund, Madras State, of *Clitoria ternatea* L., Madras, of a legume, Narsapur, Hyderabad-Dn. (259: 342).

**P. clitoriae** C. V. Subram. On dead stems of *Clitoria ternatea* L., Madras (259: 360).

**P. cookei** Mason & Ellis (*Mycol. Pap.*, 56: 72, 1953). On dead stem, Narsapur, Hyderabad-Dn. (259: 343).

**P. hispidula** (Pers. ex Pers.) Mason & Ellis (*Mycol. Pap.*, 56: 112, 1953; Sacc. IV, 308 as *Conoplea hispidula* Pers.). On dead leaves of *Cocos nucifera*, L., Ernakulam, T. C. State; on dead stem, Madras, Kambakkam Hills, Chingleput Dt., Madras State; on dead pod of *Caesalpinea pulcherrima* Sw., Madras; on dead leaf sheath of *Cocos nucifera* L., Thirurkuppam, Chingleput Dt., Madras State; on dead bamboo, Thirumalai Hills, Andhra State; on dead leaves of a palm, Coimbatore, on dead culms of *Aristida setacea* Retz., Vandalur, Chingleput Dt., Madras State; on straw, Madras (259: 352).

**P. kambakkamensis** C. V. Subram. On dead stems of bamboo, Kambakkam Hills, Chingleput Dt., Madras State (259: 352).

**P. laminella** Mason & Ellis (*Mycol. Pap.* 56: 120, 1953). On a rotting piece of bamboo, Madras (259: 360).

**P. madreeya** C. V. Subram. On dead culms of *Cynodon dactylon* Pers. and on dead bamboo, Madras (259: 356).

**P. minutissima** Corda (Sacc. IV, 273). On dead culms of *Oryza sativa* L.. Poonamallee, Chingleput Dt., Madras State (259: 345).

**P. narsapurensis** C. V. Subram. On dead wood, Narsapur, Hyderabad-Dn. (259: 345).

**P. obliqua** C. V. Subram. On dead bamboo, Madras (259: 350); on dead culms of *Cynodon dactylon* Pers., Madras (261).

**P. paludosa** Mason & Ellis (*Mycol. Pap.* 56: 94, 1953). On dead culms of grass and on dead straw, Madras (259: 347).

**P. tirupatiensis** C. V. Subram. On dead leaf rachis of *Phoenix* sp., Tirumalai Hills, Andhra State (259: 358).

**PESTALOTIA** de Not. (Sacc. **III**, 784 as *Pestalozzia*) Imp., Melanconiales (C2).

**P. seiridioides** Sacc. (Sacc. **III**, 799). On leaves of *Rosa leschnaultiana* W. & A., Ootacamund, Madras State (195: 113).

**PESTALOTIOPSIS** Steyaert (*Bull. Jard. bot. Brux.*, 19: 300, 1949) Imp., Melanconiales (C2). Guba (*Mycologia*, 47: 920-21, 1955) has recently presented convincing reasons for rejecting this generic name. Species now assigned to this genus could be placed in *Monochaetia* or *Pestalotia*.

[**P. psidii** (Pat.) Venkatakrishnaiah (Sacc. **XIV**, 1025 as *Pestalotia psidii* Pat.). On fruits of *Psidium guajava* L., Mysore (299: 164). Recorded as *Pestalotia psidii* in **M**: 40.]

**PETERSENIA** Sparrow (*Dansk. bot. Ark.* 8: 13, 1934) Phyco., Lagenidiales, Olpidiopsidaceae.

**P. panicicola** Thirum. & Lacy. On *Panicum repens*, India (*Mycopathologia*, 6: 75, 1951).

**PETRAKOMYCES** C. V. Subram. & K. Ramakr. (263: 112) Imp., Sphaeropsidales, Sphaerioidaceae (A1).

**P. indicus** C. V. Subram. & K. Ramakr. On living leaves of *?Bambusa* sp., Walayar, Malabar, Madras State (263: 112).

**PEZIZA** Dill. ex Fries (Sacc. **VIII**, 73) Asco., Pezizales, Pezizaceae.

**P. badia** Pers. (Sacc. **VIII**, 82). On the ground, India (72: 87; 251: 209).

**P. vesiculosa** Bull. (Sacc. **VIII**, 83). On cowdung, Allahabad, U.P. (214: 200, without authority).

**PHAEODIMERIELLA** Speg. (Sacc. **XXII**, 37) Asco., Sphaeriales (B2).

**P. asterinarum** (Speg.) Theiss. (Sacc. **XXII**, 37). Parasitic on colonies of *Asterina olacicola* Hansf., Nandi Hills, Mysore (280: 124).

**PHAEODOTHIS** Syd. (Sacc. **XVII**, 854). Is based on a parasitised *Phyllachora* (*Ann. mycol.*, 1939).

**P. cordifoliae** Ramakr. & Sund. On living leaves of *Jasminum cordifolium* Wall., Burliar, Nilgiris, Madras State (197: 28). Since *Phaeodothis* Syd. is not a valid genus, this species will have to be disposed elsewhere.

**PHAEOTRICHOCONIS** C. V. Subram. (*Proc. Indian Acad. Sci.*, B, 44: 2, 1956). Imp., Moniliales, Dematiaceae (C).

**P. crotalariae** (Salam & Rao) C. V. Subram. (*Proc. Indian Acad. Sci.*, B, 44: 2, 1956). On leaves and pods of *Crotalaria verrucosa* L., Agricultural College Farm, Osmania University, Hyderabad-Dn. (226: 191 as *Trichoconis crotalariae* Salam & Rao).

**PHAKOPSORA** Diet. (Sacc. **XIV**, 289 as *Phacopsora*). Basidio., Uredinales, Melampsoraceae.

**P. chorisandrae** Ramakr. & Reddy. On living leaves of *Chorisandra pinnata* W. Chittoor, Andhra State (189: 115).

[**P. desmium** (Berk. & Br.) Cumm. (*Bull. Torrey. bot. Cl.*, 42: 206, 1945). Recorded as *Cerotelium desmium* (Berk. & Br.) Arthur in **BB**: 56.]

**P. mangalorica** Ramakr. & Sund. On leaves of *Desmodium triquetrum* DC., S. Kanara (189: 118).

**P. vignae** (Bres.) Arth. (*Bull. Torrey bot. Cl.*, 44: 509, 1917; Sacc. XI, 223 as *Uredo vignae* Bres.). On living leaves of *Phaseolus lunatus* L., Kadamparai, Anamalais, Madras State (199: 145).

**PHELLINUS** Quél. = *Fomes* fide Killerman (Sacc. XII, 512 states "*Phellinus* Quél. est *Fomes* Fr."). Basidio., Agaricales, Polyporaceae.

[**P. senex** (Nees. & Mont.) Imazeki (*Bull. Govt. For. Exp. Sta, Tokyo*, 57: 115, 1952). As *Fomes senex* Nees & Mont. in BB: 97.]

**PHOMA** Sacc. (Sacc. III, 65 as *Phoma* Fr. em. Desm.) Imp., Sphaeropsidales, Sphaerioidaceae.

**P. casuarinae** Tassi (Sacc. XIV, 885). On pericarp and seed coat of *Casuarina equisetifolia* Forst., India (41: 62-63).

**P. chrysanthemicola** Hollos (Sacc. XXII, 885). On stems of *Chrysanthemum* sp., Poona, Bombay State (imported from Holland) (245: 216).

**P. hibernica** Grimes, O'Connor & Cummins. Isolated from soil, Sagar, M. P. (221: 274).

**P. sabdariffae** Sacc. (Sacc. XXV, 105). On leaves of *Hibiscus sabdariffa* L., W. Bengal (8: 145); Jorhat, Assam (56: 86).

**PHOMATOSPORA** Sacc. (Sacc. I, 432). Asco., Sphaeriales (A1).

**P. artocarpi** Ramakr. & Sund. On living leaves of *Artocarpus hirsuta* Lamk., Gudalur, Nilgiris, Madras State (196: 190).

**PHOMOPSIS** Sacc. (Sacc. XVIII, 264). Imp., Sphaeropsidales, Sphaerioidaceae.

**P. citri** Fawcett. (Sacc. XXV, 135). On leaves, twigs and fruits of *Citrus* spp., Citrus Research Station, Burnihat and other parts of Assam (58: 323).

**P. orchidophila** Cash & Watson. On stems, leaves etc., of *Coelogyne barbata, Cymbidium aloifolium* and *Vanda coerulea*, India (43: 740).

**PHRAGMIDIUM** Link (Sacc. VII, 742). Basidio., Uredinales, Pucciniaceae.

"**P. malvacearum**" (without authority). On species of Rosaceae, Gauhati, Assam (32: 301)

**PHYLLACHORA** Nits. (Sacc. II, 594). Asco., Dothideales, Phyllachoraceae (A1).

**P. amphididyma** Penz. & Sacc. (Sacc. XIV, 664 as *P. amphidyma* Penzig & Sacc.). On *Salacia* sp., Coorg, S. India (285: 758).

**P. cyperi** Rehm (Sacc. II, 606). On living culms of *Fimbrystylis* sp., Madras (187: 257).

**P. dolichogena** (Berk. & Br.) Sacc. (Sacc. II, 601). On living leaflets of *Dolichos lablab* L., Wynad, Malabar Dt., Madras State (198: 63).

**P. flemingiae** Ramakr. & Sund. On living leaflets of *Flemingia semialata* Roxb., Pannaikadu, Madurai Dt., Madras State (199: 142).

**P. hugoniae** Theiss. & Syd. (Sacc. XXIV, 595). On living leaves of *Hugonia mystax* L., Tirupati, Andhra State (189: 111); Tambaram and Kambakkam, Chingleput Dt., Madras State; Karaikudi, Ramanathapuram Dt., Madras State (K. R., unpublished).

**P. kambakkamensis** K. Ramakr. On living leaves of *Ochna* sp., Thanthipandal, Kambakkam, Chingleput Dt., Madras State (184: 121).

**P. kanarensis** Ramakr. & Sund. On living leaves of *Hopea wightiana* W., Mangalore, S. Kanara, Madras State (197: 29).

**P. minuta** P. Henn. (Sacc. XVII, 832). On living leaves of *Hibiscus tiliaceous* Linn., Alwaye, T. C. State (201: 192); Pullepady, Ernakulam, T. C. State (187: 257).

[**P. pterolobii** (Ramakr. T. S. & K) Arx & Mueller (10: 175). Recorded as *Physalospora pterolobii* Ramakr, T. S. & K, in RS: 35].

**P. scolopiae** Ramakr. & Sund. On living leaves of *Scolopia crenata* Clos. Burliar, Nilgiris, Madras State (197: 29).

**P. travancorica** Ramakr. nom nov. for *P. tetraspora* K. Ramakr. non *P. tetraspora* Chardon (1932, *J. Dep. Agric. Puerto Rico*, 16: 178). On living leaves of *Polyalthia longifolia* Hook. & Thomp., Botanic Garden, Trivandrum, T. C. State (184: 123). *P. tetraspora* Chardon was recorded on *Bambos vulgaris*.

[**P. tetraspora** K. Ramakr. (184: 123). This is a later homonym of *P. tetraspora* Chardon. See *Phyllachora travancorica*.]

**P. uppalii** nom. nov. for *Phyllachora indica* Uppal, Patel & Bhide on *Dimeria ornithopoda* recorded in **RS**: 34 nec. *Phyllachora indica* Theiss. & Syd. (**Sacc. XXIV**, 589; **BB**: 34). *P. indica* Uppal, Patel & Bhide is a later homonym of *P. indica* Theiss. & Syd.; but the two fungi are clearly different.

**P. ventilaginis** Ramakr. & Sund. On living leaves of *Ventilago maderaspatana* Gaertn., Kallar, Coimbatore Dt., Madras State (200: 18).

**PHYLLACTINIA** Lév. (Sacc. I, 5). Asco., Erysiphales, Erysiphaceae.

[**P. guttata** (Fr.) Lév. (**Sacc. I**, 5 as *P. guttata* (Wallr.) Lév. under *P. suffulta* (Reb.) Sacc.) Recorded as *P.corylea* (Pers.) Karst. in **BB**: 36. According to the International Rules as amended in 1950 the correct name should be *P. guttata* fide W. B. Cooke (61: 574).]

**P. thirumalachari** Payak. On fallen leaves of *Cordia dichotoma* Forst., Sukhanand Temple, Jawad, Mandsaur Dt., M.B. (175: 312).

**PHYLLOSTICTA** Pers. ex Desm. (Sacc. III, 3). Imp., Sphaeropsidales, Sphaerioidaceae.

**P. galligena** Moreau. Parasitic on *Parmelia perforata*, India (153: 100-102).

[**P. glumarum** (Ell. & Tr.) Miyake (*J. Coll. Agric. Tokyo*, 2: 252, 1910). Recorded as *Phoma glumarum* Ell. & Tr. **BB**: 160.]

**P. hederae** Sacc. & Roum. (Sacc. III, 20). On living leaves of *Hedera helix* L., Ootacamund, Madras State (202: 61).

**PHYLLOSTICTINA** Syd. (Sacc. XXV, 79). Imp., Sphaeropsidales, Sphaerioidaceae.

[**P. musarum** (Cke.) Petr. (*Ann. mycol.* 29: 268, 1931). Recorded as *Macrophoma musae* (Cke.) Berl. & Vogl. in **BB**: 158.]

**P. pyriformis** Cash & Watson. On leaves and stems of *Cypripedium insigne* India (43: 738).

**PHYSALOSPORA** Niessl. (Sacc. I, 433). Asco., Sphaeriales (A1).

**P. camptospora** Sacc. (Sacc. XIV, 522). On *Coelogyne* sp., India (43: 736).

**P. clerodendri** Ramakr. On living leaves of *Clerodendron infortunatum* L., S. Kanara, Madras State (200: 18).

**P. jasmini** Ramakr. & Sund. On living leaves of *Jasminum rigidum* Zenk. Pannakadu, Madura Dt., Madras State (199: 143).

**P. wildemanniana** Sacc. (Sacc. XIV, 522). On orchid, India (43: 736).

**PHYSODERMA** Wallr. (Sacc. VII, 317). Phyco., Chytridiales, Cladochytriaceae.

**P. aneilemae** Pavgi & Thirum. On living leaves of *Aneilema nodiflorum* R. Br., Banaras, U.P. (172: 94).

**P. brachiariae** Thirum. & Pavgi. On leaves of *Brachiaria distachya* (L.) Haines, Patna, Bihar (288: 153).

**P. commelinae** Lingappa. In stems of *Commelina nodiflora* L., in stems, leaves and petioles of *Cyanotis axillaris* D.Don., and *Aneilema nodiflorum* R. Br., Banaras, U.P. (138: 110).

**P. corchori** Lingappa. In stems, petioles and veins of *Corchorus olitorius* L., and *C. acutangulus* Lam, Banaras, U.P. (138: 109).

**P. cynodontis** Pavgi & Thirum. On living leaves of *Cynodon dactylon* Pers., Banaras, U.P. (172: 91).

**P. dichanthicolum** Pavgi & Thirum. On living leaves of *Dichanthium annulatum* (Forsk.) Stapf, Banaras, U.P., Patna, Bihar (288: 153).

**P. digitariae** Pavgi & Thirum. On living leaves of *Digitaria royleana* Prain, Banaras, U.P. (172: 94).

**P. echinochloae** Thirum. & Whitehead. On leaves of *Echinochloa crusgalli* Beauv., Patna, Bihar (292: 694); Banaras, U.P. (172: 95).

**P. eriochloae** Pavgi & Thirum. On living leaves of *Eriochloa procera* Hubb., Banaras, U.P. (172: 92).

**P. graminis** (Büsgen) de Wildemann (Sacc. XI, 250 as *Cladochytrium graminis* Büsgen). On *Cynodon dactylon* Pers., Banaras, U.P. (288: 149).

**P. maculare** Wallr. (Sacc. VII: 317). On living leaves of *Alisma reniformis* Banaras, U.P. (288: 154).

**P. nelumbi** Mishra & Thirum. On leaves of *Nelumbium speciosum* Willd., Pavapuri, Bihar (281: 83).

**P. setaricola** Pavgi & Thirum. On leaves of *Setaria glauca* Beauv., Banaras, U.P. (172: 93).

**PHYTOPHTHORA** de Bary (Sacc. VII, 237). Phyco., Peronosporales, Pythiaceae.

**P. cyperi-bulbosi** Seethalakshmi & Ramakr. On leaves of *Cyperus bulbosus* Vahl., Coimbatore, Madras State (233: 150; 232: 58).

**PIRICULARIA** Sacc. (Sacc. IV, 217)., Imp., Moniliales, Moniliaceae (C).

**P. aquatica** Ingold (*Trans. Brit. mycol. Soc.,* 26: 111, 1943). In ponds, Gauhati, Assam (32: 310).

**P. grisea** (Cke.) Sacc. (Sacc. IV, 217). On leaves and neck of *Eleusine coracana* Gaertn., Ranchi Dt., Bihar (282: 146).

**PLAGIONEMA** C. V. Subram. & K. Ramakr. (264: 134). This has been shown to be a synonym of *Ciliochorella* Syd. (52: 74-75). See also Subramanian and Ramakrishnan, in *Trans. Brit. mycol. Soc.,* 39, 1956.

[**P. indica** C. V. Subram. & K. Ramakr. (264: 134). This has been shown to be a synonym of *Ciliochorella mangiferae* Syd. (52: 74-75). See also Subramanian and Ramakrishnan, in *Trans. Brit. mycol. Soc.,* 39.]

**PLASMOPARA** Schroet. (Sacc. VII, 239). Phyco., Peronosporales, Peronosporaceae.

**P. vernoniae-chinensis** Saw. (*Agri. Exp. Sta. Govt. Formosa Spec. Bull.,* 19: 98, 1919) On living leaves of *Vernonia cinerea* Less., Coimbatore, Madras State (198: 61).

**P. wildemanniana** P. Henn. v. **macrospora** Sawada (see *Mycologia* 14: 81, 1922). On leaves of *Rungia parviflora* Nees, Bhagalpur, (45: 196).

**PLEUROTUS** (Fr.) Quél. (Sacc. V, 339) Basidio., Agaricales, Agaricaceae.

[**P. belangeri** (Mont.) Dennis (74: 121).Recorded as *Trogia belangeri* (Mont.) Fr. in BB: 132.].

**PODOCONIS** Boedijn (*Bull. Jard. bot. Buitenz.,* Ser. III, 13: 133, 1933). Imp., Moniliales, Dematiaceae (C).

**P. macrura** (Sacc.) Hughes (*Mycol. Pap.,* 50: 58, 1953; Sacc. XXV, 828 as *Helminthosporium macrurum* Sacc.). On dead rachis of *Phoenix sylvestris* Roxb., Tambaram, Chingleput Dt., Madras State (249: 162 as *Podoconis theae* (Bernard) Boedijn).

**PODOSPHAERA** Kunze ex Lév. (Sacc. I, 2). Asco., Erysiphales, Erysiphaceae.

**P. clandestina** (Wallr. ex. Fr.) Lév. var. **tridactyla** (Wallr.) W. B. Cooke (61: 572). On apricot seedlings, Chaubattia, U.P. (84: 43-46 as *P. oxycanthae* (DC.) de Bary var. *tridactyla* (Wallr.) Salmon).

**POLYCLYPEOLUM** Theiss. (Sacc. XXIV, 527). Asco., Hemisphaeriales, Polystomellaceae.

**P. salvadorae** K. Ramakr. On living leaves of *Salvadora persica* Linn., Ennore, Chingleput Dt., Madras State (184: 119).

**POLYDESMUS** Mont. (Sacc. IV, 401) ? = *Alternaria*. Imp., Moniliales. Dematiaceae (C).

**P. indicus** C. V. Subram. On dead spathe of *Cocos nucifera* Linn., Ernakulam, T.C. State (256: 33).

**POLYPORUS** Mich. ex Fr. (Sacc. VI, 55). Basidio., Agaricales, Agaricaeae.

**P. betulinus** Fr. (Sacc. VI, 139). On *Pinus khasiana*, Nongpo, Assam (32: 303, without authority).

"**P. cinerescens** Petch" (Sacc. XXV, 376 gives *P. cinerescens* Lév.). On *Pongamia glabra* Vent. (208: 23).

[**P. consors** (Berk.) Stevenson. (Sacc. II, 486 as *Irpex consors* Berk.) On dead *Quercus semecarpifolia* Deoban, Kanthian, Chakrata, U.P.; Mundali, U.P.; Garsha, Kulu, Panjab; on dead *Q. incana*, Bashahr; on green *Q. semecarpifolia*, Simla, Panjab; on dead *Q. dilatata*, Mundali, Chakrata, U.P. (18: 28). *Coriolus consors* (Berk.) Imazeki (*Bull. Tokyo Sci. Mus.*, 6: 80, 1943) is another name for this fungus. See also *Polyporus consors* (Berk.) Teng, 1934. Recorded as *Irpex consors* Berk. in **BB**: 103.]

**P. palustris** Berk. & Curt. (Sacc. VI, 139 as *P. paluster* Berk. & Curt.). On drift wood causing rot and on *?Picea morinda*, Kokilamukh, Jorhat, Assam (16: 375).

**P. similis** Berk. (Sacc. VI, 69). Naini Tal, U.P. (149: 181, without authority).

**POLYSTICTUS** Fr. (Sacc. VI, 208) = *Coltricia*. Basidio., Agaricales, Polyporaceae.

?**P cuticularis** Wahlenberg (Sacc. VI, 249 under *Polystictus vulpinus* Fr.) Naini Tal, U.P. (149: 181).

**P. sector** (Ehrenb.) Fr. (Sacc. V, 285). On *Shorea robusta* Gaertn., India (14: 21).

**P. venulosus** Jungh. (Sacc. VI, 241). On *Shorea robusta* Gaertn., India (14: 21).

**PORIA** Pers. ex S. F. Gray (Sacc. VI, 292). Basidio., Agaricales, Polyporaceae.

**P. metamorphosa** Fuck. (Sacc. VI, 315). On dead wood?, Naini Tal, U.P. (148: 180).

**P. rhizomorpha** Bagchee. On dead stems and roots of *Gmelina arborea* Linn., *Taraktogenos kurzii* King and *Melocanna bambussoides* Trin., evergreen forests of North Bengal and North Assam (13: 30).

**P. rixosa** Karst. (Sacc. VI, 303). Causing decay of conifers, Chakrata division, U.P., Kulu division, Panjab; Bashahr division, H.P. (19: 793).

**PRATHIGADA** C. V. Subram. nom nov. for *Macraea* C. V. Subram. (249: 164) non Lindl. 1830 et Wight, 1852. Imp., Moniliales, Dematiaceae (C).

[**P. crataevae** (Syd.) C. V. Subram. comb. nov. (249: 166 as *Macraea crataevae* (Syd.) Subram.; Sacc. XXV, 836 as *Napicladium crataevae* Syd.). Recorded in M: 35 as *Napicladium crataevae*.]

**P. punjabensis** (C. V. Subram.) C. V. Subram. comb. nov. syn. *Macraea punjabensis* C. V. Subram. On living leaves of *?Craetaeva religiosa* Forst. Karnal, Panjab (249: 166 as *Macraea punjabensis*).

**PRATHODA** C. V. Subram. (260: 73). Imp., Moniliales, Stilbaceae (E2).

**P. saparva** C. V. Subram. On dead stems, Narsapur, Hyderabad, Dn. (260: 73).

**PROTOMYCOPSIS** P. Magn. (Sacc. XXIV, 1317). Asco., Taphrinales, Protomycetaceae.

**P. crotalariae** Joshi. On living leaves of *Crotalaria triquetra* Dalz., Mount Abu, Rajasthan (122: 168).

**P. patelii** Pavgi & Thirum. see *P. phaseoli*.

[**P. phaseoli** (Patel, Kulkarni & Dhande) Ramakr. & Subram. comb. nov. Recorded in RS: 46 as *Synchytrium phaseoli* Patel, Kulk., & Dhande. Pavgi & Thirumalachar (171: 315) have shown that the fungus is a *Protomycopsis* and they proposed the new name *P. patelii*. This seems to be unnecessary as the nov. comb., *P. phaseoli* would be correct according to the rules.]

**PSEUDOBOTRYTIS** Krzemieniewska & Badura, (*Acta Soc. bot. Poloniae*, 23: 774, 1954) Imp., Moniliales, Dematiaceae (B).

**P. terrestris** (Timonin) C. V. Subram. (*Proc. Indian Acad. Sci.*, B, 43: 277, 1956). On dead stems, Coonoor, Nilgiris, Madras State (260: 86 as *Umbellula terrestris* (Timonin) Morris).

**PSEUDOCAMPTOUM** Frag. & Cif. (*Bol. R. Soc. Espanola*, 25: 453, 1925) = *?Melanographium* Sacc. (Sacc. XXV, 936) fide Hughes (*Canad. J. Bot.* 31, 1953). Imp., Moniliales, Dematiaceae (A).

**P. fasciculatum** (Cke. & Mass.) Mason (in Ciferri, *Estac. Agron. de Moca*, Ser. B. Botan., 14, 155, 1929; Sacc. XI, 613 as *Monotospora fasciculata* Cke. & Mass.). On dead peduncles of *Cocos nucifera* L., Ernakulam, T. C. State; on dead leaf sheaths of *Phoenix canariensis* Chabaud, Sim's Park, Coonoor, Madras State (258: 289).

**PSEUDOPLECTANIA** Fuckel. (Sacc. VIII, 165). Asco., Pezizales, Pezizaceae.

**P. kumaonensis** Sanwal. On dead and rotting *Quercus* wood and on the ground, Lohaghat, Kumaon, U.P. (229: 191).

**PUCCINIA** Pers. (Sacc. VII, 600). Basidio., Uredinales, Pucciniaceae

**P. amphilophidis** Doidge (*Bothalia*, 3: 496, 1939). On living leaves of *Amphilophis pertusa* Stapf, Coimbatore, Madras State (198: 63).

[**P. anthistiriae** Barclay, recorded in BB: 64. Cummins (64: 82-83) comments on this rust as follows: "The host of this rust originally considered to be *Anthistiria anathera*, has been examined by J. R. Swallen and found to be a species of *Agropyron*. Two urediospores found with the teliospores, were oblong and possessed four equatorial pores. The rust undoubtedly is *Puccinia graminis* Pers."]

**P. arthraxonis-ciliaris** Cummins. On *Arthraxon hispidus* (Thumb.) Merrill, Poombarai Valley, Pulneys (64: 16-17).

**P. brizae-maximae** Ramakr. & Sund. On *Briza maxima* L., Agricultural Research Station, Nanjanad, Nilgiris, Madras State (197: 30).

**P. bulbostylidis** Doidge (*Bothalia*, 2: 117, 1926). On leaves and peduncles of *Bulbostylis barbata* Kunth., Pattambi, Malabar, Madras State. (192: 89).

**P. chloridis-incompletae** Ramakr., Sriniv., & Sund. On leaves of *Chloris incompleta* Roth., Kallar, Coimbatore Dt., Madras State (192: 91).

**P. curcumae** Ramakr. & Sund. On living leaves of *Curcuma* sp., Mundage, S. Kanara, Madras State (196: 192).

**P. desertorum** Syd. (Sacc. XXI, 664). On leaves of *Evolvulus alsinoides* L., Kallar, Coimbatore Dt., Madras State (192: 90).

**P. elytrariae** P. Henn. (Sacc. XIV, 326). On living leaves of *Justicia betonica* L., Sultan's Battery, Wynad, Madras State (201: 193).

[**P. eulaliae** Barclay, recorded in **BB**: 67 is a *nomen dubium* fide Cummins (64: 18-19). Cummins classifies Barclay's fungus under *P. erianthi* Padwick & Khan recorded in **RS**: 38].

**P. garnotii** Ramakr. & Sund. On living leaves of *Garnotia arundinacea* Hk., Burliar, Nilgiris, Madras State (197: 30).

**P. gymnopetali-wightiae** Ramakr., Sriniv. & Sund. On leaves of *Gymnopetalum wightii* Arn., Pannaikadu, Madura Dt., Madras State (192: 90).

**P. intermixta** Peck (Sacc. VII, 672). On *Iva axillaris,* Naini Tal, U.P. (148: 179, without authority).

**P. kalchbrenneri** De Toni (Sacc. VII, 645). On living leaves of *Helichrysum buddleoides* DC., Ootacamund, Madras State (193: 88).

**P. kunthiana** Ramakr., Sriniv. & Sund. On living leaves of *Isachne kunthiana* W. & A., Ootacamund, Madras State (193: 88).

**P. levis** (Sacc. & Bizz.) Magn. (Sacc. XVII, 395 under *Diorchidium levis* Sacc. & Bizz.) On living leaves of *Digitaria marginata* Link., Kallar, Coimbatore Dt., Madras State (193: 89).

**P. malvacearum** Mont. (Sacc. VII, 686). On leaves of *Malva verticillata* L., Keti, Nilgiris, Madras State (189: 119).

**P. operculinae** Ramakr. & Sund. On leaves of *Operculina turpethum* S. Manso., Walayar, Malabar, Madras State (195: 111).

**P. padwickii** Cummins. On *Cyathula tomentosa* Moq., Naini Tal, U.P. (63: 224). *Uredo gomphrenae* Barcl., recorded in **BB**: 78 is the uredial stage of this fungus, fide Cummins.

**P. pectiniformis** Ramakr., Sriniv. & Sund. On living leaves of *Vernonia pectiniformis* DC., Ootacamund, Madras State (193: 89).

**P. pogonatheri** Petch. (Sacc. XXIII, 743). On living leaves of *Pogonatherum paniceum* (Lam.) Hack., Singampatti, Tirunelveli Dt., Madras State (197: 31), Coimbatore, Madras State (64: 36).

[**P. sacchari** Patel, Kamat & Padhye recorded in **RS**: 39 = *P. erianthi* Padwick & Khan (**RS**: 38) fide Cummins (64: 19).]

**P. substriata** Ell. & Barth. (Sacc. XIV, 348). On living leaves of *Paspalum scrobiculatum* L., Coimbatore, Madras State (198: 64).

**P. terminaliae** (Ramakr. T. S. & K.) Ramakr. & Sund. On living leaves of *Terminalia bellerica* Roxb., Valparai, Coimbatore Dt., Madras State (199: 145). Recorded as *Aecidium terminaliae* Ramakr. T. S. & K. in **RS**: 5.

**P. tiliaefolia** Ramakr. & Sund. On living leaves of *Grewia tiliaefolia* Vahl., Ambalavayal, Malabar, Madras State (201: 194).

**PUCCINIOSTELE** Tranz. & Komarow (Sacc. XVI, 321). Basidio., Uredinales, Pucciniaceae.

**P. sydowii** Lion & Wang (*Chinese J. Bot.* 1: 81, 1936). On *Astilbe* sp., India (65: 45). Cummins and Thirumalachar (65: 45) state "It is doubtful if this species differs from *P. clarkiana* (Barcl.) Diet."

**PULLULARIA** Berkh. (*De schimmelgeschlachten* Monilia, Oidium, Oospora *en* Torula. These Fac. Sci. Univ. Utrecht, 1923). Imp., Moniliales, Pseudosaccharomycetaceae = or possibly = *Kabatiella.*

**P. pullulans** (de Bary) Berkh. (Sacc. V, 351 as *Dematium pullulans* de Bary & Low. under *Cladosporium herbarum* (Pers.) Link.). Isolated from the atmosphere, Kanpur, U.P. (181: 36).

**PYRONEMA** Carus (Sacc. VIII, 107). Asco., Pezizales, Pezizaceae.

**P. omphaloides** (Bull.) Fuck. (Sacc. VIII, 107). On burnt, denuded ground, Majkhali, Kumaon, U.P. (229: 198).

**PYTHIUM** Pringsh. (Sacc. VII, 270). Phyco., Peronosporales, Pythiaceae.

**P. mamillatum** Meurs (144: 99). Isolated from soil, Vandalur, Madras State (183: 54; 186: 112).

**P. spinosum** Sawada (144: 95). Causing decline of *Anacardium occidentale* L., Kozhikode, Malabar, Madras State (190: 61).

**RAMARIA** Holmsk ex S. F. Gray (Sacc. VI, 692 under *Clavaria;* see 62: 124). Basidio., Agaricales, Agaricaceae.

**R. flaccida** (Fr.) Ricken (62: 576 ; Sacc. VI, 703 as *Clavaria flaccida* Fr.). On humus under oak forest, The Park, Mussoorie; on dead leaves and dead twigs under oak forest; on dead pine needles under pine forest, The Park, Mussoorie; on humus under oak forest, Dhobi Ghat, Mussoorie, all in the Panjab (269: 93).

**R. fumigata** (Peck) Corner v. **gigantea** Thind and Anand. On soil, Chakrata Toll, Mussoorie, Panjab (269: 98).

**R. obtusissima** (Peck) Corner (62: 609; Sacc. XXIII, 487 as *Clavaria obtusissima* Peck). On soil under oak forest, Chakrata Toll, Mussoorie (69: 101, 'rough spored form').

**R. stricta** (Fr.) Quél. v. **concolor** Corner (62: 623). On rotting stumps and logs of trees in oak forest, The Park, Mussoorie; on humus amid mosses and on dead leaves of *Quercus incana* Roxb., under oak forest, The Park Mussoorie, all in the Panjab (269: 96). Thind and Anand (269: 97) also record a "dark coloured form" on fallen dead pine needles, The Park, Mussoorie.

**R. subbotrytis** (Coker) Corner (62: 625). On soil under oak forest, Chakrata Toll, Mussoorie, Panjab (269: 98).

**RAMULARIA** Sacc. (Sacc. IV, 196 as *Ramularia* Ung. em. Sacc.). Imp., Moniliales, Moniliaceae (C).

**R. grewiae** Lacy & Thirum. On leaves of *Grewia asiatica* Roxb., Patna, Bihar (280: 126).

**R. gymnematis** Ramakr. & Sund. On leaves of *Gymnema sylvestris* R. Br., Kallar, Coimbatore Dt., Madras State (198: 65).

**R. tinosporae** Lacy & Thirum. On leaves of *Tinospora cordifolia* Miers, Patna, Bihar (280: 126).

**RAMULISPORA** Miura (*S. Manch. agr. Bull.,* 11: 43, 1920) = *Titaeospora* fide Clements & Shear. Imp., Melanconiales.

**R. capparidis** Ramakr. & Sund. On living leaves of *Capparis grandiflora* Wall., Maruthumalai, Coimbatore, Madras State (196: 193).

**RAVENELIA** Berk. (Sacc. VII, 770). Basidio., Uredinales, Pucciniaceae.

**R. acaciae-senegalae** Sanwal. On living leaves of *Acacia senegal* Willd., The Ridge, Delhi (228: 414).

**R. acacicola** Sanwal. On living leaves of *Acacia senegal* Willd., The Ridge, Delhi (228: 414).

**R. ajmerensis** Sanwal. On living leaves of *Acacia* sp., Adarshnagar, Ajmer, Rajasthan (228: 415).

**R. clemensiae** Syd. (*Ann. mycol.* **26**: 418, 1928). On living leaflets of *Albizzia procera* (Roxb.) Benth., Walayar, Malabar, Madras State (**195: 112**).

**R. coimbatorica** Ramakr. & Sund. On leaves of *Phyllanthus urinaria* L., Kallar, Coimbatore Dt., Madras State (**189: 119**).

**R. hansfordii** Cumm. (*Bull. Torrey bot. Cl.*, **57**: 214, 1945). On leaflets of *Acacia suma* Buch-Ham., Walayar, Malabar, Madras State (**195: 112**).

**R. hansfordii** Cumm. v. **ferrugineae** Ramakr. & Sund. On living leaves of *Acacia ferruginea* DC., Walayar, Malabar, Madras State (**195: 113**).

**R. sayeedii** Salam & Ramachar (**225**: 213, nomen nudum without diagnosis), Hyderabad Dn.

**RHIZOPUS** Ehr. ex. Corda (**Sacc. VII**, 212). Phyco., Mucorales, Mucoraceae.

**R. nigricans** Ehr. v. **minutus** Chowdhury (*Ann. mycol.* 32: 91, 1934). Paddy soil, Gauhati, Assam (**32**: 297). The record in **M**: 11 is from Pakistan.

**R. nodosus** Namyslowski (**Sacc. XXI**, 823). Isolated from interior of cotton seeds, Madras (**300**: 101); from paddy soil, Gauhati, Assam, (**32**: 297); isolated from soil, Sagar, M.P. (**221**: 274). The record in **M**: 11 is from Pakistan.

**R. oryzae** Went & Prinzen Geerlings (**Sacc. XI**, 240). Isolated from tobacco field soils, Vedasandur, Coimbatore Dt., Madras State (**251**: 208; **306**: 109).

**R. stolonifer** (Fr.) Lind. (**158**: 133 as a synonym of *R. nigricans*). Isolated from the atmosphere, Kanpur, U.P. (**181**: 36).

**RHODOTORULA** Harrison (*Trans. Roy. Soc. Canada*, **22**: 187, 1928). Imp., Moniliales, Pseudosaccharomycetaceae.

**R. minuta** (Saito) Harrison (**139**: 663). Isolated from sea water, Bombay (**31**: 26).

**R. mucilaginosa** (Jorg.) Harrison (**139**: 655). Isolated from sea water, Bombay (**31**: 26).

**R. pallida** Lodder (**139**: 664). Isolated from sea water, Bombay (**31**: 26, without authority).

**RHYTIDHYSTERIUM** Speg. (**Sacc. II**, 759). Is an earlier name for *Tryblidiella* Asco., Helotiales.

[**R. rufulum** (Spreng.) Petrak (*Sydowia*, **5**: 186, 1951). Recorded in **BB**: **14** as *Tryblidiella rufula* (Spreng.) Sacc.]

**ROBILLARDA** Sacc. (**Sacc. III**, 407). Imp., Sphaeropsidales, Sphaerioidaceae.

**R. depazeoides** (W. & C.) Sacc. (**Sacc. III**, 408). Isolated from soil, Madras (**183**: 79).

**ROSTROSPORA** Subram. & Ramakr. (**262**: 67). Imp., Melanconiales.

[**R. ciliata** (Ramakr. T. S. & K.) C. V. Subram. & K. Ramakr., Recorded in **RS**: 15 as *Colletotrichum ciliatum* Ramakr. T. S. & K.]

**RUSSULA** Pers. ex S. F. Gray (**Sacc. V**, 453). Basidio., Agaricales, Agaricaceae.

**R. lepida** Fr. (**Sacc. V**, 461). On the ground in pine forests, Kodaikanal, Madras State (**192**: 94).

**SACCHAROMYCES** Meyen ex Hansen (**Sacc. VIII**, 916). Asco., Endomycetales, Saccharomycetaceae

**S. fructuum** Lodder & Kreger van Rij (**139**: 669). Isolated from sea water, Bombay (**30**: 13; **31**: 26, without authority).

**S. rosei** (Guilliermond) Lodder & Kreger van Rij. (**139**: 197). Isolated from sea water, Bombay (**30**: 13; **31**: 26, without authority).

**S. steineri** Lodder & Kreger van Rij. (139: 668). Isolated from sea water, Bombay (30: 13, 31: 26 without authority).

**SAKSENAEA** Saksena (217: 434). Phyco., Mucorales.

**S. vasiformis** Saksena. In soil, Patharia forests, Sagar, M.P. (217: 434; 221: 276).

**SAPROLEGNIA** Nees ex? Pringsh. (Sacc. VII, 268; 59: 22). Phyco., Saprolegniales, Saprolegniaceae.

**S. ferax** (Gruith.) Thuret. (59: 40). In ponds, Gauhati, Assam (32: 296).

**SAPROMYCES** Fritsch (Sacc. XIV, 456). Phyco., Leptomitales, Rhipidiaceae.

**S. indicus** Iyengar, Ramakr. & Subram. On dead leaves in water in a fresh water stream in Kambakkam near Madras (114: 144).

**SAPUCCHAKA** K. Ramakr. (188: 115). Asco., Hemisphaeriales, Microthyriaceae (A1).

**S. madreeya** K. Ramakr. On dead twigs of *Quisqualis indica* Linn., Madras (188: 116).

**SARTORYA** Vuillemin (*C. R. Acad. Sci., Paris,* 184: 136, 1927). Asco., Eurotiales, Eurotiaceae.

[**S. fumigata** Vuill. (*C. R. Acad. Sci., Paris,* 184: 136, 1927), is the correct name for *Aspergillus fumigatus* Fres. recorded in BB: 140 fide Benjamin (27: 678).]

**SCHIFFNERULA** Hoehn. (Sacc. XXII, 27). Asco., Erysiphales, Englerulaceae.

**S. malabarensis** Ramakr. & Sund. On living leaves of *Passiflora edulis* Sims., Wynad, Malabar, Madras State (196: 188).

**SCHROETERIA** Winter (Sacc. VII, 500). Basidio., Ustilaginales, Tilletiaceae.

**S. delastrina** (Tul.) Wint. (Sacc. VII, 500). In ovaries of *Veronica verna* L., Naugaum, Kashmir (173: 91).

**SCLEROPHTHORA** Thirum., Shaw & Naras (290: 304). Phyco., Peronosporales, Peronosporaceae.

**S. macrospora** (Sacc.) Thirum., Shaw & Naras. (Sacc. IX, 342 as *Sclerospora macrospora* Sacc.) On *Eleusine coracana*, Bangalore (290: 304).

**SCLEROSPORA** Schroet. (Sacc. VII, 238). Phyco., Peronosporales, Peronosporaceae.

[**S. andropogonis-sorghi** (Kulk.) Kulk. ex Safee. & Thirum. is the correct name for *S. sorghi* Weston & Uppal recorded in M: 10 and *S. graminicola* v. *andropogonis-sorghi* Kulk. recorded in BB: 7 fide Safeeulla and Thirumalachar (213: 177).]

**S. dichanthicola** Thirum. & Naras. In culms of *Dichanthium annulatum* Stapf, Patna, Bihar (284: 598).

**SCLEROTIUM** Tode ex Fr. (Sacc. XIV, 1139). Mycelia sterilia.

**S. delphinii** Welch. On garden lilies, Gauhati, Assam (23: 304; 32: 309).

**SCOPULARIOPSIS** Bain. (Sacc. XXV, 681). Imp., Moniliales, Moniliaceae (A).

**S. brevicaulis** (Sacc.) Bain. (Sacc. XXV, 681). On a larva of *Calandra glandinum* Dehra Dun, U.P. (176: 73 as *Penicillium brevicaule* Sacc.); isolated from soil, Sagar, M.P. (221: 238); from tan liquor, Bangalore (66: 175 as *Penicillium brevicaule* and without authority).

**SEPTOBASIDIUM** Pat. (Sacc. XI, 118). Basidio., Tremellales, Septobasidiaceae.

**S. bogoriense** Pat. (Sacc. XVI, 184). On *Thea sinensis* L., Jorhat, Assam (32: 307, without authority).

**S. pseudopedicellatum** Burt (Sacc. XXIII, 561). On *Citrus assamensis* Dutt & Battacharjee, *C. grandis* Osbeck, *C. reticulata* Blanco, *C. limon* Brun., *C. paradisi* Macf., Jorhat, Assam (55: 264).

**SEPTONEMA** Corda (Sacc. **IV**, 397). Imp., Moniliales, Dematiaceae (C).

**S. harknessii** (Ellis) Hughes (*Canad. J. Bot.*, 31: 585, 1953; **Sacc. IV**, 488 as *Dendryphium harknessii* Ellis). On dead leaf base of *Phoenix canariensis* Chabaud, Sim's Park, Coonoor, Madras State (**258**: 291).

**S. indica** Ramakr. Isolated from soil, Vandalur, Madras State (**186**: 112, *nomen nudum*, without diagnosis).

**SEPTORIA** Sacc. (Sacc. **III**, 474). Imp., Sphaeropsidales, Sphaerioidaceae (E).

**S. delonicis** Ramakr. & Sund. On living leaflets of *Delonix elata* Gamb., Coimbatore, Madras State (**199**: 147).

**S. hexandrae** Kand. & Sund. On living leaves of *Manilkara hexandra*, Coimbatore, Madras State (**124**: 210).

**S. lycopersici** Speg. (Sacc. **III**, 535). On living leaves of *Lycopersicon esculentum* Mill., Cinchona, Anamalais and Coonoor, Nilgiris, Madras State (**199**: 148).

**S. nodorum** Berk. (Sacc. **III**, 561). On *Triticum dicoccum* Kotagiri, Nilgiris, Madras State (**51**: 17).

**S. selenophomoides** Cash & Watson. On leaves of *Bulbophyllum* sp., *Coelogyne cristata, C. elata, Cymbidium devonianum, C. pendulum, C. whitiae, Cypripedium insigne, C.* sp., India (**43**: 741).

**SOROSPORIUM** Rud. (Sacc. **VII**, 511). Basidio., Ustilaginales, Ustilaginaceae.

[**S. aristidae-cynanthae** (Bref.) Zundel (**307**: 53). Recorded as *Sphacelotheca aristidae-cynanthae* (Bref.) Pavgi & Mundk. in **RS**: 43 and as *Ustilago aristidae-cynanthae* Bref. in **BB**: 47.]

[**S. barberi** (Mundk.) Ling, (**131**: 46). Recorded as *Ustilago barberi* Mundk. in **RS**: 51.]

**S. brachiariae-ramosae** Ramakr. In ovaries of *Brachiaria ramosa* Stapf, Pollachi, Coimbatore Dt., Madras State (**189**: 113).

**S. consanguineum** Ell. & Ev. var. **bullatum** Pavgi & Thirum. In ovaries of *Aristida adscenscionis* Linn., Banaras, U.P., and *A. hystrix*, New Delhi (**169**: 10).

[**S. nardi** (H. & P. Syd.) Ling, (**131**: 47). Recorded as *Ustilago nardi* H. & P. Syd. in **BB**: 49.]

**S. paspali** McAlp. var. **verrucosum** Thirum. & Pavgi. In inflorescence of *Paspalum scrobiculatum*, Netrahat, Bihar (**281**: 81).

[**S. paspali-thunbergii** (P. Henn.) S. Ito (*Trans. Sapporo nat. Hist. Soc.*, **14**: 94, 1935). Recorded as *Sorosporium paspali* McAlp. in **BB**: 45 (vide **307**: 69).]

**S. setaricolum** Thirum. & Safee. In the inflorescence of *Setaria pallidifusca* Stapf, Makut, Coorg. (**289**: 439).

**S. turneri** McAlp. (Sacc. **XXI**, 514). In the ovaries of *Eragrostis* sp., Majhgawan, U.P. (**170**: 319).

**SPEGAZZINIA** Sacc. (Sacc. **IV**, 758). Imp., Moniliales, Tuberculariaceae (G).

**S. sundara** C. V. Subram. On dead bamboo, Corporation Zoo, Madras; on dead leaves of *Ananas sativus* Schult. f., Chingavanam, T. C. State (**260**: 78).

[**S. tessarthra** (Berk. & Curt.) Sacc. is the correct name for *S. ornata* Sacc. recorded in **RS**: 43 (vide **260**: 74).]

**SPHACELOMA** de Bary (Sacc. **XX**, 815). Imp., Melanconiales (A1).

**S. fici** Thirum. On leaves of *Ficus glomerata* ?Mysore (**270**: 55-66).

**S. hesperthusae** Jenkins & Bitancourt. On rind of fruit, peduncle and leaves of *Hesperthusa crenulata* (Roxb.) Roem., Calcutta, Botanical Garden near Sibpur, Coromandel coast including forests of the Eastern ghats near

Penagaluru (alt. 300-1000 m.) Cuddapah Dt., Andhra State, and of *Pleiospermum alatum* (Wt. & Arn.) Swing., Eastern Ghats near Penagaluru (117: 236).

**S. terminaliae** Bitancourt (*Arch. Inst. biol. Def. agric. anim., S. Paulo*, VIII, 13: 197-200, 1937). On *Terminalia bellerica*, Mysore (270: 55-66).

**SPHACELOTHECA** de Bary (**Sacc. VII**, 499). Basidio., Ustilaginales, Ustilaginaceae.

**S. bicornis** (P. Henn.) Zundel (*Mycologia*, 22: 140, 1930; **Sacc. XIV**, 419, as *Ustilago bicornis* P. Henn.). In inflorescence of *Cymbopogon flexuosus* (Steud.) Watson, Nandi Hills, Mysore (170: 318).

**S. consimilis** Thirum. & Pavgi. In inflorescence of *Saccharum munja* Roxb., Patna, Bihar (287: 100).

[**S. digitariae** (Kunze) Clinton is the correct name for *Ustilago digitariae* (Kze.) Rabenh. recorded in **BB:** 48, fide Zundel (307: 88).]

**S. elaeocharidis** Thirum. & Pavgi. In ovaries of *Elaeocharis* sp., Netrahat, Bihar (287: 99).

[**S. iseilematis** (Syd. & Butl.) Zundel (307: 95) is a later homonym of *S. iseilematis* (Syd. & Butl.) Mundk. & Thirum., 1950 recorded in **RS:** 44.]

[**S. kobresiae** (Mundk.) Pavgi & Thirum. (173: 92). Recorded as *Cintractia kobresiae* Mundkur in **RS:** 14.]

[**S. manilensis** (Syd.) Ling. (131: 43) is the correct name for *S. sacciolepidis* Thirum., recorded in **RS:** 45.]

**S. mcalpineae** Zundel (*Mycologia*, 31: 538, 1939). In inflorescence of *Heteropogon contortus* L., Ajmer, Rajasthan (121: 62).

**S. mysorensis** Pavgi & Thirum., In ovaries of *Capillipedium hugelii* (Hack.) A. Camus, Bedur, Shimmoga, Mysore (286: 394).

[**S. operta** (H. & P. Syd. & Butl.) Zundel (307: 186). Recorded as *Ustilago operta* Syd. H. & P., & Butl. in **BB:** 50.]

[**S. ophiuri** (P. Henn.) Ling (*Sydowia*, 3: 127, 1949). *Ustilago flagellata* Syd. recorded in **RS:** 51 is a synonym of this fungus fide Ling (133: 331).]

**S. schweinfurthiana** (Thum.) Sacc. v. **minor** Zundel (*Mycologia*, 35: 168, 1943). In ovaries of *Saccharum munja* Roxb., Banaras, U.P. (173: 91).

**SPHAEROSTILBE** Tul. (**Sacc. II**, 511). Asco., Hypocreales, (B1).

**S. hypocreoides** Kalch. & Cke. (**Sacc. II**, 515). On bamboo, various parts of Orissa (159: 119).

**SPHAEROTHECA** Lév. (**Sacc. I**, 3). Asco., Erysiphales, Erysiphaceae.

[**S. macularis** (Wallr. ex Fr.) W. B. Cooke is the correct name for *S. humuli* (DC.) Burr., recorded in **BB:** 38 fide W. B. Cooke (61: 572).]

[**S. macularis** (Wallr. ex Fr.) W. B. Cooke var. **fuliginea** (Schlecht. ex. Fr.) W. B. Cooke is the correct name for *S. humuli* var. *fuliginea* recorded in **BB:** 38 fide W. B. Cooke (61: 572).]

[**S. pannosa** (Wallr. ex Fr.) Lév. is the correct citation for *S. pannosa* (Wallr.) Lév., recorded in **BB:** 39, fide W. B. Cooke (61: 572).]

**SPIROPES** Ciferri (*Sydowia* 9: 302, 1955). Imp., Moniliales, Dematiaceae (C).

**S. guareicola** (Stev.) Cif. (*Sydowia*, 9: 303, 1955; **Sacc. XXV**, 832 as *Helminthosporium guareicolum* Stev.). Parasitic on Meliolineae, on living leaves of unidentified angiosperm, Castle Rock, Bombay State (**260:** 64 as *Helminthosporium guareicola*).

**SPONDYLOCLADIUM** Mart. ex Corda (**Sacc. IV**, 482). Imp., Moniliales, Dematiaceae (C).

**S. australe** Gilman & Abbott (*Iowa St. Coll. J. Sci.*, 1: 1927) Isolated from soil, Sagar, M.P. (223: 78; 221: 276).

**SPORIDESMIUM** Link. ex Fr. (Sacc. IV, 497). Imp., Moniliales, Dematiaceae (D).

**S. nilgirense** C. V. Subram. On dead stems of *Bambusa nana* Hort., Government Gardens, Ootacamund, Madras State (260: 79-80).

**SPOROTRICHUM** Link ex Fr. (Sacc. IV, 96). Imp., Moniliales, Moniliaceae (C).

**S. epigaeum** Brunard v. **terrestre** Daszew. Isolated from soil, Allahabad, U.P. (216: 76; 215: 37).

**S. indicum** Cast. & Chalmers (*Manual of Trop. Med.*, 622, 1910; 85: 809). On man, Calcutta (88: 570 as *S. beurmanni* Matruchot & Ramond *v. indicum* Castellani).

**STACHYBOTRYS** Corda (Sacc. IV, 269) . Imp., Moniliales, Dematiaceae (A).

**S. atra** Corda (Sacc. IV, 269). On dead leaf base of *Musa paradisiaca* L., Madras; on dead leaf sheath of *M. paradisiaca*, Ernakulam, T. C. State and on paper, Madras (248: 48); isolated from soil, Madras (5: 98).

**S. pulchra** Speg. (Sacc. XIV, 1071). On dead leaf of *Ficus bengalensis* L., Madras (248: 50).

**STARKEYOMYCES** Agnihothrudu (4: 41). Imp., Moniliales, Tuberculariaceae (A1).

**S. koorchalomoides** Agni. Isolated from the rhizosphere of *Cajanus cajan* (Linn.) Millsp., Madras; soil from scrub jungle, Mt. Abu, Bombay, from soil, Ahmedabad, Bombay State; rhizosphere soil of *Naregamia alata* W. & A., Nilambur, Malabar, Madras State; of *Tectona grandis* L., from Top Slip, Anamalais, Madras State; of *Nicotiana tabacum,* Vijayawada, Andhra State; garden soil, Bangalore (4: 41-42).

**STEMPHYLIUM** Wallr. (Sacc. IV, 519). Imp., Moniliales, Dematiaceae (D).

**S. consortiale** (v. Thuemen) Groves & Skolko (Sacc. IV, 539 as *Macrosporium consortiale* Thuemen). Isolated from tent ropes, India (205: 79).

**STEREOFOMES** Rick (*Broteria*, ser. trimest. III, Fasc. 4, 170, 1934). Basidio., Agaricales, Thelephoraceae.

[**S. annosus** (B. & C.) Rick. (*Broteria* III, Fasc. 4, 171, 1934. Recorded as *Stereum annosum* B. & C. in M: 28.]

**STIGMINA** Sacc. (Sacc. IV, 394). Imp., Moniliales, Dematiaceae (C).

[**S. maculata** (Cooke) Hughes. Recorded as *Clasterosporium maculatum* Cke., in BB: 145 (vide 260: 80).]

[**S. palmivora** (Sacc. apud. Trelease) Hughes. Recorded as *Exosporium palmivorum* Sacc. in BB: 145 (vide 260: 82).]

**STILBOSPORA** Pers. ex Fr. (Sacc. III, 771). Imp., Melanconiales (C2).

**S. celtidis** Ramakr. & Sund. On living leaves of *Celtis tetrandra* Roxb., Burliar, Nilgiris, Madras State (197: 34).

**S. grewiae** Ramakr. & Sund. On living leaves of *Grewia asiatica* Mas., Kodur (193: 94).

**STYSANUS** Corda (Sacc. IV 620). Imp., Moniliales, Stilbaceae (A2).

**S. monilioides** (Alb. & Schw.) Corda (Sacc. IV, 621). On *Citrus chrysocarpa* Lush., Darjeeling, W. Bengal (208: 31).

**SYNCEPHALIS** van Tiegh. & Le Monnier (Sacc. VII, 227). Phyco., Mucorales, Piptocephalidaceae.

**S. cornu** van Tiegh. (Sacc. VII, 232). Parasitic on the hyphae of *Cunninghamella echinulata;* isolated from soil, Vandalur, Madras State (183: 232; 186: 112).

**S. reflexa** van Tiegh. (Sacc. VII, 232). Parasitic on the hyphae of *Cunninghamella bertholletiae* Stadel, isolated from soil, Vandalur, Madras State (183: 61; 186: 112).

**SYNCHYTRIUM** de Bary & Woronin (**Sacc. VII**, 288). Phyco., Chytridiales, Synchytriaceae.

**S. akshaiberi** Lingappa. On leaves, petioles and stems of *Solanum melongena* L., Banaras, U.P. (**134**: 292; **137**: 843).

**S. alysicarpi** Ramakr. & Sund. On living leaves of *Alysicarpus vaginalis* DC., Walayar, Malabar, Madras State (**200**: 17).

**S. ampelocissi** Mishra. On leaves and stems of *Ampelocissus latifolia* Planch., Darbhanga, Bihar (**146**: 152).

**S. asystaciae** Payak & Thirum. On *Asystasia dalzelliae* Santapau, Khandala, Bombay State (**174**: 342 without diagnosis, *nomen nudum*).

**S. biophyti** Lingappa. On *Biophytum reinwardtii* Edg., & Hook. f. Banaras, U.P. (**136**: 140; **137**: 843).

**S. brownii** Karling (*Sydowia*, 8: 27, 1954). On *Oenothera biennis* L., and *O. laciniata* Hill, Banaras (**137**: 843).

**S. cassiae** Lingappa. On *Cassia pumila* Lam., Banaras, U.P. (**136**: 139; **137**: 843).

**S. celosiae** Gupta & Sinha. On leaves of *Celosia argentea* L., Agra, U.P. (**108**: 78).

**S. cissampelum** Singh. On leaves and stems of *Cissampelos pareira* L., Hazipur, Bihar (**234**: 369).

**S. cookei** Lingappa. On leaves and stems of *Alysicarpus monilifer* DC., Banaras, U. P. (**134**: 291; **137**: 843).

**S. crustatum** Lingappa. On *Indigofera enneaphylla* L. and *I. linicola* Retz., Banaras, U.P. (**136**: 132; **137**: 843).

**S. cyamopsae** Gupta & Sinha. On stems and leaves of *Cyamopsis psoraloides* DC., Agra, U.P. (**108**: 78).

**S. emeliae** Ramakr. & Sund. On petiole and lamina of *Emelia sonchifolia* DC., Bantwal, S. Kanara (**196**: 187).

**S. endobioticum** (Silbs.) Percival (**Sacc. XIV**: 447 as *Chrysophlyctis endobiotica*). On potato tubers, Rungbull seed Potato Farm, Darjeeling Dist., W. Bengal, (**87**: 606).

**S. hibisci** Gupta & Sinha. On leaves and stems of *Hibiscus esculentus* L., Agra, U.P. (**107**: 8).

**S. khandalensis** Payak & Thirum. On *Blepharis asperrima* Nees, Khandala, Bombay State (**174**: 342 without diagnosis, *nomen nudum*).

**S. launeae** Lingappa. On *Launea asplenifolia* Hook. f., Banaras, U.P. (**136**: 130; **137**: 843). Recorded as *S. vulgatum* Rytz in **RS**: 47.

**S. maculans** Lingappa. On *Sida rhombifolia* L., Banaras, U.P. (**136**: 138; **137**: 843).

**S. meliloti** Lingappa. On leaves and stems of *Melilotus indica* All., Banaras, U.P. (**134**: 293; **137**: 847).

**S. melongenae** Gupta & Sinha. On leaves of *Solanum melongena* L., Agra, U.P. (**107**: 8).

**S. micranthum** Singh. On leaves and stems of *Micranthus oppositifolia* Wendl., Begusarai, Bihar (**234**: 369).

**S. millingtonicolum** Safee. & Govindu. On *Millingtonia hortensis* Linn., Bangalore (**211**: 320; **137**: 847).

[**S. minutum** (Pat.) Gäum. On *Pueraria tuberosa* DC., Sagar, Mysore State (**135**: 271). As *Woroninella puerariae* (Pat.) Syd. in **BB**: 2. Lingappa (**135**: 271) states "Mhatre and Mundkur could not trace any herbarium specimens of this species in any Indian herbaria and up to the present time the record of its occurrence in India is unsubstantiated."]

**S. oldelandiae** Lingappa. On aerial parts of *Oldenlandia corymbosa* Lam., Banaras, U.P. (**136**: 139).

**S. oroxyli** Lingappa. On *Oroxylon indicum* L., Banaras, U.P. (**136**: 136; **137**: 843).

**S. phaseoli-radiati** Sinha & Gupta. On leaves of *Phaseolus radiatus, P. mungo, Cajanus cajan* (Linn.) Millsp. and *Crotalaria juncea*, Agra, U.P. (**107**: 7).

**S. phyllanthi** Lingappa. On *Phyllanthus simplex* Retz., and *P. urinaria* L., Banaras, U.P. (**136**: 131; **137**: 845).

**S. rhynchosiae** Lingappa. On *Rhynchosia aurea* DC., Banaras, U.P. (**136**: 140; **137**: 847).

**S. sesami** Sinha & Gupta. On leaves and stems of *Sesamum indicum* L., Agra, U.P. (**107**: 8).

**S. thirumalachari** Lingappa. On *Atylosia scarabeoides* Benth., Banaras, U.P. (**136**: 141; **137**: 847).

**S. trichodesmatis** Lingappa. On *Trichodesma indicum* R.Br., Banaras, U.P. (**136**: 136; **137**: 845).

**S. vernoniae** Gupta & Sinha. On stems of *Vernonia patula* (Dryand) Merr., Agra, U.P. (**107**: 9).

**S. viticola** Lingappa. On *Vitis trifolia* L., Banaras, U.P. (**136**: 141; **137**: 847).

**S. wurthii** Rytz (**Sacc. XXI**, 841). On *Bryonopsis laciniosa* Nand., *Coccinia indica* W. & A., *Cucumis sativus* L., *Cucurbita maxima* Duchesne, *Lagenaria vulgaris* Ser., *Luffa aegyptiaca* Mill., *Momordica charantia* L., *Trichosanthes dioica* Roxb., Banaras, U.P. (**137**: 845).

**S. zorniae** Lingappa. On *Zornia diphylla* Pers., Banaras, U.P. (**136**: 134; **137**: 845).

**TALAROMYCES** Benjamin (**27**: 681). Asco., Eurotiales, Eurotiaceae.

**T. luteus** (Zukal) Benjamin (**27**: 681; **Sacc. XI**, 593 and **204**: 600 as *Penicillium luteum* Zukal). Causing rice spoilage, Calcutta (**141**: 126 as *Penicillium luteum*, without authority; we take it that the authors are referring to Zukal's binomial and not to others found in literature); in soil, Chinsurah, W. Bengal (**208**: 30 as *Penicillium luteum* Thom); on cotton and jute fabrics, Calcutta (**7**: 421; **25**: 285 as *Penicillium luteum*, without authority); isolated from soil, Allahabad, (**178**: 120 as *Penicillium luteum*, without authority).

**T. vermiculatus** (Dang.) Benjamin (**27**: 684; **Sacc. XXII**, 1278 as *Penicillium vermiculatum* Dang.) isolated from soil, Calcutta (**68**: 214; **156**: 215 as *Penicillium vermiculatum* Dang.); on fibre, Calcutta (**24**: 92; **26**: 154 as *Penicillium vermiculatum* Dang.); from soil, W. Bengal (**155**: 221 as *Penicillium vermiculatum*, without authority); on jute cloth, Calcutta (**34**: 190 as *Penicillium vermiculatum*, without authority).

[**T. wortmannii** (Kloecker) Benjamin (**27**: 683). Recorded as *Penicillium wortmannii* Kloecker in **BB**: 149.]

**TAPHRINA** Fr. (**Sacc. VIII**, 812). Asco., Taphrinales, Taphrinaceae.

[**T. tubiforme** (Rabenh.) Lagerh. should be the correct name for *T. cornu-cervi* Giesenhagen recorded in **BB**: 9 fide Thirumalachar (**271**, 26).]

**THAROOPAMA** C. V. Subram. (**260**: 84). Imp., Moniliales, Stilbaceae (A2).

**T. trina** C. V. Subram. On dead culms of grass (*Cynodon dactylon* Pers.,?) and on dead pods of *Caesalpinia pulcherrima* Sw., University Botany Laboratory campus, Madras (**260**: 85).

**THECAPHORA** Fingerh. (Sacc. VII, 507). Basidio., Ustilaginales, Ustilaginaceae.

[**T. aterrima** Tul. var. **fimbristylidis** (Mundk. & Thirum.) Mundk. & Thirum. (157: 58). Recorded in **RS**: 47 as *Thecaphora fimbristylidis* Mundk. & Thirum.]

**THIELAVIA** Zopf (Sacc. I, 39). Asco., Eurotiales, Eurotiaceae.

**T. basicola** Zopf (Sacc. I, 39). Isolated from soil, Vandalur, Madras State (183: 64; 186: 112). The conidial stage was recorded from Pakistan in **BB**: 39.

**T. terricola** (Gilman & Abbot) Emmons (*Bull. Torrey bot. Cl.* 57: 124, 1930). Isolated from paddy field soil, Agricultural Farm, Chinsurah, W. Bengal (46: 70).

**TILLETIA** Tul. (Sacc. VII, 481). Basidio., Ustilaginales, Tilletiaceae.

**T. apludae** Thirum. & Mishra. In ovaries of *Apluda aristata* L., Parasnath, Bihar (281: 81).

**T. biharica** Thirum. & Pavgi. In ovaries of *Panicum* sp., Parasnath, Bihar (287: 101).

**T. digitaricola** Pavgi. & Thirum. In ovaries of *Digitaria royleana* Prain, Allahabad, U.P. and *D. adscendens* Hens. var. *fimbriata* (Stapf) R. & S., Allahabad, U.P. and Patna, Bihar (286: 393).

**T. makutensis** Thirum. & Safee. In ovaries of *Setaria pallidifusca* Stapf. Makut, Coorg (289: 440).

**T. narasimhanii** Thirum. & Safee. In ovaries of *Panicum trypheron* Schult., Patna, Bihar (289: 442).

**T. panici-humilis** Pavgi & Thirum. In ovaries of *Panicum humile* Nees, Banaras, U.P. (173: 89).

**T. pulcherrima** Ell. & Gall. v. **brachiariae** Pavgi & Thirum. In ovaries of *Brachiaria distachya* Stapf, and *Eriochloa procera* Hubb., Banaras, U.P. (170: 323).

**T. perotidis** Thirum. & Pavgi. In ovaries of *Perotis indica* L., Patna, Bihar (286: 392).

**T. setaricola** Pavgi & Thirum. In ovaries of *Setaria intermedia* R. & S., Banaras, U.P. (170: 321).

**T. themedae-anatherae** Pavgi. & Thirum. In ovaries of *Themeda anathera* Hack., Mussoorie (173: 89).

**T. themedicola** Mishra & Thirum. In ovaries of *Themeda quadrivalvis* Kuntz, Parasnath, Bihar (281: 81).

**T. transvalensis** Zundel (*Mycologia*, 23: 299, 1931). In ovaries of *Eragrostis plumosa* Stapf, Banaras, U.P. (169: 10; 157: 65); of *E. tenuifolia* Hochst. Bangalore (103: 224).

**T. verrucosa** Cke. & Mass. (Sacc. IX, 286). In ovaries of *Panicum trypheron* Schult., Patna, Bihar (286: 392).

**TITAEOSPORA** Bubak (Sacc. XXV, 630). Imp., Melanconiales (C1).

**T. daphniphylli** Ramakr. & Sund. On living leaves of *Daphniphyllum neilgherrense* Ros., Burliar, Nilgiris, Madras State (197: 34).

**T. pterolobii** Ramakr. & Sund. On living leaflets of *Pterolobium indicum* A. Rich, Kallar, Coimbatore Dt., Madras State (202: 64).

**TOLYPOSPORELLA** Atk. (Sacc. XIV, 427). Basidio., Ustilaginales, Ustilaginaceae.

**T. sporoboli** Jackson (*Mycologia* 18: 122, 1926). On living leaves of *Sporobolus wallichii* Munro, Walayar, Malabar, Madras State (200: 22).

**TOLYPOSPORIUM** Woron. (**Sacc. VII**, 501). Basidio., Ustilaginales, Ustilaginaceae.

**T. andropogonis** Patel & Kulkarni. In inflorescence of *Andropogon triticeus* R.Br., Poona, Bombay State (**165**: 65).

**TORULA** Pers. ex Fr. (**Sacc. IV**, 247). Imp. Moniliales, Dematiaceae (A).

**T. herbarum** (Pers.) Link ex Fr. (**Sacc. IV**, 256). On dead leaf sheath of *Cocos nucifera* L., Madras; dead leaf rachis of *Cocos nucifera* L., Ernakulam T. C. State; on dead peduncles of *Areca catechu* L., Thotumukham, Alwaye, T. C. State; on dead leaf sheath of *Musa paradisiaca* L., Ernakulam, T. C. State; on dead stem of *Acalypha wickesiana* Muell Arg., Madras; on dead stem of *Artocarpus integrifolia* L., Ernakulam, T. C. State; on dead stem of *Cajanus cajan* (L.) Millsp., Madras; on dead stem of *Barleria* sp., Changanacherry, T. C. State; of ?Crassulalaceae, Madras; of Rubiaceae, Ernakulam, T. C. State; dead stem, Changanacherry, T. C. State (**248**: 43); on dead stem of *Jasminum* sp., Madras; on dead wood, Pannaikudu, Kodaikanal, Madras State; on dead stem, Coonoor, Nilgiris, Madras State; on dead stem of *Croton sparsiflorus* M. Arg., and *Gynandropsis* sp., Gingee, S. Arcot, Dt., Madras State (**261**).

**TORULOPSIS** Berl. (**Sacc. XVIII**, 495). Imp., Moniliales, Pseudosaccharomycetaceae.

**T. candida** (Saito) Lodder (**139**: 414). Isolated from sea water, Bombay (**30**: 13; **31**: 26).

**T. dattila** (Kluyver) Lodder (**139**: 406). Isolated from sea water, Bombay (**31**: 26).

**T. famata** (Harrison) Lodder & Kreger van Rij (**139**: 417). Isolated from sea water, Bombay (**30**: 13; **31**: 26).

**T. glabrata** (Anderson) Lodder & de Vries (**139**: 407). Isolated from sea water, Bombay (**30**: 13; **31**: 26).

**TRABUTIA** Sacc. & Roum. (**Sacc. I**, 449). Asco., Dothideales.

**T. osbeckiae** Ramakr. & Sund. On living leaves of *Osbeckia octandra* DC., Wynad, Malabar, Madras State (**200**: 19).

**TRAMETES** Fr. (**Sacc. VI**, 334). Basidio., Agaricales, Polyporaceae.

[**T. acuta** (Berk.) Imazeki (*Bull. Tokyo Sci. Mus.* **6**: 73, 1943) Recorded as *Lenzites acuta* Berk., in **BB**: 106.]

**T. cinnabarinus** Jacq. (**Sacc. VI**, 353 as *T. cinnabarina* (Jacq.) Fr.) Howrah, Bengal (**208**: 26).

**T. corrugata** (Pers.) Bres. On *Shorea robusta* Gaertn., India (**14**: 21).

**T. incerta** (Curr.) Cke. (**Sacc. VI**, 352). On *Shorea robusta,* Gaertn., India (**14**: 21); on *Lagerstroemia parviflora,* Khanapara, Assam (**32**: 305). The record in **BB**: 131 is from Burma.

**T. suaveolens** (L.) Fr. (**Sacc. VI**, 338). Naini Tal, U. P. (**148**: 180, without authority).

**TREMATOSPHAERELLA** Kirscht. (**Sacc. XXII**, 248) is near *Trematosphaeria* Asco., Sphaeriales, (C2).

[**T. oryzae** (Miyake) Padwick (**162**: 154). Recorded as *Phaeosphaeria oryzae* Miyake in **BB**: 32.]

**TREMELLODENDROPSIS** (Corner) D. A. Crawford (*Trans. roy. Soc. N.S.W.*, 82: 618, 1954). Basidio., Agaricales, Clavariaceae.

**T. pusio** (Berk.) D. A. Crawford (*Trans. roy. Soc. N. S. W.* **82**: 620, 1954; **Sacc. VI**, 710 as *Clavaria pusio* Berk.; **62**: 188 as *Aphelaria pusio* (Berk.) Corn.). On soil under oak forest, Kempty Road, Mussoorie, Panjab (**269**: 92 as *Aphelaria pusio* (Berk.) Corner).

**TRICHOPHYTON** Malmsten (Sacc. XV, 424; 85: 527). Imp., Moniliales, Dermatophytes.

**T. concentricum** Blanchard (60: 253; 85: 490 as *Epidermophyton concentricum* (Blanchard) Cast. & Chalmers). On man, Kamrup, Assam (83: 5 as *Epidermophyton concentricum* Blanchard).

**T. ferrugineum** (Ota) Langeron & Miloch. (60: 255; "possibly a variant of *Microsporum ferrugineum*" Dodge (85: 545). On man, Calcutta (78: 195), Shillong, Assam (143: 151). Both records as *Microsporum ferrugineum* and without authority for the name.

**T. mentagrophytes** (Robin) Blanchard (Sacc. IV, 100 as *Sporotrichum (Microsporon) mentagrophytes* Rob.; 60: 251). On man, Calcutta (96: 83, 97: 83 as *Trichophyton gypseum,* without authority).

**T. rubrum** (Cast.) Sabouraud. On man, Calcutta (96: 83, 97: 83 as *T. purpureum,* without authority); India (78: 195, without authority).

**T. schoenlini** (Lebert) Langeron & Milochevitch. (Sacc. XXII, 1336 as *Achorion schoenlini* Remak = *Oidium schoenlini* Lebert; 60: 253). On man, India (77: 416 as *Achorion schoenlini,* without authority).

**T. tonsurans** Malmsten (85: 531). On man, Calcutta (92: 382; 82: 411; 78: 195 as *T. crateriforme,* without authority).

**T. violaceum** Sabouraud (60: 255; 85: 554 gives *T. violaceum* Kusunoki (1913)). On man, Calcutta (92: 382; 97: 83; 96: 83; 78: 195, without authority), on man, India (91: 269, without authority), on scalp of man, Calcutta (80: 541 as *Achorion violaceum*).

**T. violaceum** Sab. v. **indicum** Acton & McGuire. On man, Calcutta (3: 241), on man, India (78: 195).

**TRICHOSPORIUM** Fr. (Sacc. IV, 288). Imp., Moniliales, Dematiaceae (A).

**T. fuscum** (Link) Sacc. (Sacc. IV, 289). In paddy soil, Gauhati, Assam (32: 309 as *T. fuscum* Sacc.).

**TRICHOTHECIUM** Link ex Fr. (Sacc. IV, 178). Imp., Moniliales, Moniliaceae (B).

**T. roseum** Link (Sacc. IV, 178 as *T. roseum* (Pers.) Link). In paddy soil, Gauhati, Assam (32: 309). The record in **M**: 37 is from Pakistan

**TROCHOPHORA** Moore (47: 90). Imp., Moniliales, Moniliaceae (F). = *Helicostilbe* Linder 1929 non *Helicostilbe* Hoehn., 1902.

**T. simplex** (Petch) Moore (152: 90). On *Daphniphyllum neilgherrense* Rosenth., Kotagiri, Nilgiris, and Kodaikanal, Madura Dt., Madras State (123: 76 as *Helicostilbe simplex* Petch).

**UNCINULA** Lév. (Sacc. I, 6). Asco., Erysiphales, Erysiphaceae.

[**U. salicis** (DC. ex Merat) Wint. is the correct citation for *U. salicis* (DC.) Wint. recorded in **BB**: 40 fide W. B. Cooke (61: 572).]

**UREDO** Pers. (Sacc. VII, 838) Basidio., Uredinales, form genus.

**U. acalyphae-fruticosae** Ramakr., Sriniv. & Sund. On leaves of *Acalypha fruticosa* Forsk., Kallar, Coimbatore Dt., Madras State (192: 93).

**U. artocarpi** Berk. & Br. (Sacc. VII, 841). On leaves of *Artocarpus integrifolia* L., Adathorai Estate, Nilgiris, Madras State (189: 120).

**U. brachylepissae** Ramakr. & Sund. On leaves of *Brachylepis nervosa* W. & A., Burliar, Nilgiris, Madras State (197: 31).

**U. celastri-paniculatae** Ramakr. & Sund. On living leaves of *Celastrus paniculatus* Willd., Burliar, Nilgiris, Madras State (197: 32).

**U. ciceris-arietini** (Grogn.) Jacz. & Boyer (**Sacc. VII**, 844 as *U. ciceris-arietini* Grogn.). On *Cicer arietinum* L., Darjeeling, W. Bengal (**208: 14**).

**U. citri** Vaheeduddin. On leaves of *Citrus paradisci* Macfad., Ali Sagar, Nizamabad Dt., Hyderabad-Dn., (**295: 345**).

**U. emeliae-scabrae** Ramakr. & Sund. On living leaves of *Emelia scabra* DC., Burliar, Nilgiris, Madras State (**197: 33**).

**U. ravannae** Maire (**Sacc. XXIII**, 931). On living leaves of *Erianthus arundinaceous* (Retz.) Fesw., Coimbatore, Madras State (**197: 33**).

**U. rhinacanthi** Ramakr. & Sund. On living leaves of *Rhinacanthus communis* Nees, Burliar, Nilgiris, Madras State (**197: 32**).

**U. terminaliae** P. Henn. (**Sacc. XIV**, 391). On leaves of *Terminalia chebula* Mahableshwar, Bombay State (**165: 64**).

**UROCYSTIS** Rabenh. (**Sacc. VII**, 515). Basidio., Ustilaginales, Tilletiaceae.

**U. anemones** (Pers.) Wint. (**Sacc. VII**, 518 as *U. anemones* (Pers.) Schroet.). On stems and petioles of *Ranunculus* sp., Marpolar Pass (15,000 ft.) Kashmir (**169: 11**).

[**U. agropyri** (Preuss.) Schroet. (**Sacc. VII**, 516). *U. poae* (Liro) Padwick & Azmat. recorded in **RS: 50** is a synonym of this fungus fide Pavgi and Thirum. (**160: 11**).]

**UROMYCES** Link. (**Sacc. VII**, 531). Basidio., Uredinales, Pucciniaceae.

**U. amphilophis-insculptae** Ramakr., Sriniv. & Sund. On living leaves of *Amphilophis insculpta* Stapf, Musiri, Trichinopoly Dt., Madras State (**192: 92**).

**U. anotis-monospermae** Ramakr. & Sund. On living leaves of *Anotis monosperma* Benth., Nanjanad, Nilgiris, Madras State (**201: 194**).

**U. clignyi** Pat. & Har. (**Sacc. XVI**, 268). On leaves of *Eremopogon foveolatus* Stapf, Coimbatore, Madras State, (**193: 91**).

**U. cyathulae** P. Henn. (**Sacc. XI**, 179). On *Cyathula capitata*, Naini Tal, U.P. (**148: 179**).

[**U. ignobilis** (Syd.) Arth. (**109: 260**). Recorded as *Uredo ignobilis* in **BB: 79**.]

[**U. acori** Ramakr. & Rang. is now named *U. sparganii* Clint. & Peck, ssp. *asiaticus* Parmelee & Savile (**164: 833**).]

[**U. sparganii** Clint. & Peck (**Sacc. VII**, 572). Recorded as *U. acori* Ramakr. & Rang. in **RS: 50**. *U. acori* is considered a synonym of *U. sparganii* Clint. by Parmelee and Savile (**164: 833**) and made a sub-species as *U. sparganii* ssp. *asiaticus* Parm. & Sav.]

**U. tripogonicola** Payak & Thirum. On *Tripogon lisboae* Stapf, Purandhar Hill fort, Bombay State (**174: 343**, *nomen nudum*, no diagnosis).

**USTILAGINOIDEA** Bref. (**Sacc. XIV**, 431). Imp., Moniliales, Dematiaceae.

**U. oplismeni** Ramakr. & Sund. In ovaries of *Oplismenus burmannii* Beauv., Walayar, Malabar, Madras State (**189: 112**).

**USTILAGO** (Pers.) Roussel (**Sacc. VII**, 451). Basidio., Ustilaginales, Ustilaginaceae.

[**U. andropogonis-finitimi** Maublanc, reported in **RS: 51** is considered by Ling (**131: 46**) to be *Sorosporium barberi* (Mundk.) Ling. Ling states that *U. andropogonis-finitimi* Maubl. is a Hyphomycete.]

[**U. anomala** Kunze var. **cordai** (Liro) Savile (*Canad. J. Bot.*, **31: 669, 1953**) Recorded as *U. cordai* Liro in **RS: 51**.]

**U. bullata** Berk. (**Sacc. VII**, 468). Stated to occur in India by Ling (**133: 317**); no host specified.

**U. caricis-wallichianae** Thirum. & Pavgi. In ovaries of *Carex wallichiana* Presc., Ramgarh, U.P. (287: 98).
**U. deserticola** Speg. (**Sacc. XVI**, 371). In ovaries of *Chloris villosa*, Surat, Bombay State (165: 64).
**U. neglecta** Niessl (**Sacc. VII**, 472). Stated to occur in India by Ling (133: 32); no host specified.
**U. ornata** Tracy & Earle (**Sacc. XIV**, 417). In ovaries of *Leptochloa filiformis*, Allahabad, U.P. (173: 91).
**U. striiformis** (Westend) Niessl. On undetermined grass, Sonamarg, Kashmir, (157: 38).

**VARICOSPORIUM** Kegel (*Ber. d. deutsch. bot. Ges.*, 24: 213-16, 1906) Imp. Moniliales, Moniliaceae (G).
**V. elodeae** Kegel (*Ber. d. deutsch. bot. Ges.*, 24: 213-16, 1906). In ponds, Gauhati, Assam (32: 310, without authority).
**VERMICULARIA** Fr. (**Sacc. III**, 221). Imp., Melanconiales (A1). A synonym of *Colletotrichum* Corda fide Duke (*Trans. Brit. mycol. Soc.*, 13, 1928).
[**V. indica** (Dastur) Vassiljevsky (*Fungi Imperfecti Parasitii*, 2: 348, 1950) Recorded as *Colletotrichum indicum* Dastur in **M**: 38.]
**VERTICILLIUM** Nees ex Wallr. (**Sacc. IV**, 150) Imp., Moniliales, Moniliaceae (A).
**V. glaucum** Bonorden (**Sacc. IV**, 157). On tentage, jute canvas, waterproof cotton canvas and various cordages, Kanpur, U.P., on bamboo, forward area (7: 422, without authority); atmosphere, Kanpur, U.P. (181: 36).
**VESTERGRENIA** Rehm (**Sacc. XVI**: 465 under *Guignardiella* Sacc. & Syd. which is an obligate synonym of *Vestergrenia* Rehm) Asco., Sphaeriales (A1).
[**V. achyranthis** (Ramakr.) Arx. & Mueller (10: 170). Recorded as *Physalospora achyranthis* Ramakr. in **RS**: 35.]
[**V. heterostemmae** (Ramakr. T. S. & K.) Arx. & Mueller (10: 173). Recorded as *Physalospora heterostemmae* Ramakr. T. S. & K. in **RS**: 35.]
[**V. micheliae** (Syd.) Arx. & Mueller (10: 75). Recorded as *Phyllachorella micheliae* Syd., in **BB**: 35.]
**VOLUTINA** Penz. & Sacc. (**Sacc. XVIII**, 667). Imp., Moniliales, Tuberculariaceae (A1).
**V. concentrica** Penz. & Sacc. (**Sacc. XVIII**, 668). On dead straw, University Botany Laboratory campus, Madras (257: 42).

**WIESNERIOMYCES** Koord. (**Sacc. XXII**, 1496 as *Wisneriomyces*). Imp., Moniliales, Tuberculariaceae (C2).
**W. javanicus** Koord. (**Sacc. XXII**, 1496-97). On dead leaves of *Caesalpinia pulcherrima* Sw., University Botany Laboratory Campus, Madras (260: 87).

**ZUNDELULA** Thirum. & Naras. (283: 409). Basidio., Ustilaginales, Ustilaginaceae.
**Z. fimbristylidis** Thirum. & Naras. In ovaries of *Fimbristylis* sp., Mithapur, Patna, Bihar (283: 409); Patna, Bihar (181: 81).
**ZYGOSPORIUM** Mont. (**Sacc. IV**, 328). Imp., Moniliales, Dematiaceae (A).
**Z. oscheoides** Mont. (**Sacc. IV**, 329). On dead leaves and petioles of *Musa paradisiaca* L., rotting leaves of *Odina wodier* Roxb., Madras; on decaying leaves of *Ixora* sp., Ernakulam, T. C. State (248: 45).

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## BASONYMS (IN ITALICS), OBLIGATE AND OTHER SYNONYMS OF FUNGI LISTED

*abietina, Isaria* ≡ Hirsutella abietina
*acaciae, Septogloeum* ≡ Camptomeris acaciae
*achyranthes, Physalospora* ≡ Verstergrenia achyranthes
acori, Uromyces = Uromyces sparganii
*acuta, Lenzites* ≡ Trametes acuta
adiposum, Ceratostomella ≡ Ceratocystis adiposa
adiposum, Sphaeronema ≡ Ceratocystis adiposa
agapanthi, Mycosphaerella ≡ Mycosphaerella agapanthi-umbellati
*agropyri, Uredo* ≡ Urocystis agropyri
*albicans, Monilia* ≡ Candida albicans
*albizzicolum, Helminthosporium* ≡ Camptomeris albizzicola
alstoniae, Gloeosporium ≡ Colletotrichum alstoniae
*amaranthi, Macrosporium* ≡ Alternaria amaranthi
amstelodami, Aspergillus ≡ Eurotium amstelodami
*andropogonis, Napicladium* ≡ Curvularia andropogonis
*anemones, Uredo* ≡ Urocystis anemones
*annosum, Stereum* ≡ Stereofomes annosa
*annulata, Sphaeria* ≡ Hypoxylon annulatum
*apiculatus, Saccharomyces* ≡ Kloeckera apiculata
acquaeductuum, Fusarium = Fusarium dimerum
araucaria var. confusa, Clonostachys see Gliocladium roseum
arecae, Brachysporium ≡ Exosporium arecae
*arecae, Helminthosporium* ≡ Exosporium arecae
aristidae-cyananthae, Sphacelotheca ≡ Sorosporium aristidae-cyananthae
*aristidae-cyananthae, Ustilago* ≡ Sorosporium aristidae-cyananthae
*asperum, Sporodesmium* ≡ Dicoccum asperum
*asplenii, Cercospora* ≡ Mycosphaerella asplenii
*asterinarum, Dimerosporium* ≡ Phaeodimeriella asterinarum

barberi, Sorosporium ≡ Farysia barberi
*barberi, Ustilago* ≡ Farysia barberi
*bassiana, Botrytis* ≡ Beauveria bassiana
*belangeri, Agaricus* ≡ Pleurotus belangeri
belangeri, Trogia ≡ Pleurotus belangeri
beurmanni var. indicum, Sporotrichum ≡ Sporotrichum indicum
*bicornis, Ustilago* ≡ Sphacelotheca bicornis
bidwellii, Physalospora ≡ Guignardia bidwellii
*bidwellii, Sphaeria* ≡ Guignardia bidwellii
*brevicaule, Penicillium* ≡ Scopulariopsis brevicaulis
*brevis, Acremoniella* ≡ Monotospora brevis
*bronchialis, Monilia* ≡ Castellania bronchialis
bulbigenum v. tracheiphilum, Fusarium ≡ Fusarium oxysporum f. tracheiphilum
*bullatum, Fusarium* ≡ Fusarium equiseti var. bullatum
*butleri, Meliola* ≡ Amazonia butleri
*butleri, Sclerospora* ≡ Basidiophora butleri

*camelliae, Asterina* ≡ Clypeolella camelliae
capensis, Cercospora ≡ Helminthosporium capense
cariceti, Ophiobolus ≡ Linocarpon cariceti
*cariceti, Sphaeria* ≡ Linocarpon cariceti
*cassiicolum, Helminthosporium* ≡ Corynespora cassiicola
*cedrelae, Discella* ≡ Didymochora cedrelae
celtidis, Gyroceras ≡ Helicoceras celtidis
*celtidis, Monilia* ≡ Helicoceras celtidis
*chrysospermus, Hypomyces* ≡ Apiocrea chrysosperma
cichoracearum, Erysiphe see E. communis
*ciliatum, Colletotrichum* ≡ Rostrospora ciliata
citri, Pseudocamptoum = Pseudocamptoum fasciculatum
*citricolum, Gloeosporium* ≡ Gloeosporium spegazzinii
cladosporioides, Hormodendrum ≡ Cladosporium cladosporioides
*cladosporiodes, Penicillium* ≡ Cladosporium cladosporioides
concentricum, Achorion = Achorion indicum
concentricum, Epidermophyton ≡ Trichophyton concentricum
*congesta, Pestalozzia* ≡ Neobarclaya congesta
consors, Coriolus ≡ Polyporus consors
*consors, Irpex* ≡ Polyporus consors
*consortiale, Macrosporium* ≡ Stemphylium consortiale
*cordai, Ustilago* ≡ Ustilago anomala var. cordai
cornu-cervi, Taphrina see Taphrina tubiforme
corylea, Phyllactinia see Phyllactinia guttata
crataevae, Macraea ≡ Prathigada crataevae
*crataevae, Napicladium* ≡ Prathigada crataevae
*cyaneus, Citromyces* ≡ Penicillium cyaneum

*dahliae, Verticillium* ≡ Verticillium albo-atrum v. dahliae
*delastrina, Thecaphora* ≡ Schroeteria delastrina
*delicatum, Hydnum* ≡ Heterochaete delicata
*dematium, Vermicularia* ≡ Colletotrichum dematium
*depazeoides, Pestalotia* ≡ Robillarda depazeoides
dependens, Fomes ≡ Cryptoderma dependens
*dependens, Polyporus* ≡ Cryptoderma dependens
*desmium, Aecidium* ≡ Phakopsora desmium
desmium, Cerotelium ≡ Phakopsora desmium
*digitariae, Uredo* ≡ Sphacelotheca digitariae
digitariae, Ustilago ≡ Sphacelotheca digitariae
discoides, Trichophyton see Favotrichophyton discoides
*dolichogena, Dothidea* ≡ Phyllachora dolichogena
*durus, Polyporus* ≡ Fomes durus

earliana, Diplocarpon ≡ Fabraea earliana
*earliana, Peziza* ≡ Fabraea earliana
*effusum, Cladosporium* ≡ Cercospora effusa
*elaeagni-latifoliae, Aecidium* ≡ Endophyllum elaeagni -latifoliae
*elynae, Cintractia* ≡ Cintractia carpophila var. elynae
emodensis, Farysia ≡ Melanopsichium emodensis
emodensis, Liroa ≡ Melanopsichium emodensis
*emodensis, Ustilago* ≡ Melanopsichium emodensis

*endobiotica, Chrysophlyctis* ≡ Synchytrium endobioticum
*evolvuli, Cystopus* ≡ Albugo evolvuli

*falcatum, Acrothecium* ≡ Curvularia falcata
*farinaceum, Hydnum* ≡ Grandinia farinacea
*fasciculata, Monotospora* ≡ Pseudocamptoum fasciculatum
*ferrugineum, Microsporum* ≡ Trichophyton ferrugineum
*filamentosum, Corticium* ≡ Peniophora filamentosa
*fimbrystylidis, Thecaphora* ≡ Thecaphora aterrima var. fimbristylidis
*filaccida, Clavaria* ≡ Ramaria flaccida
*flaccidus, Agaricus* ≡ Lenzites flaccida
flagellata, Ustilago see Sphacelotheca ophiuri
fumigatus, Aspergillus ≡ Sartorya fumigata

*gelatinosa, Mollisia* ≡ Calloriopsis gelatinosa
*geniculatum, Helminthosporium* ≡ Curvularia geniculata
*gilva, Lachnea* ≡ Patella gilva
*glumarum, Phoma* ≡ Phyllosticta glumarum
gomphrenae, Uredo see Puccinia padwickii
*gracilipes, Sphaerostilbe* ≡ Nectria gracilipes
*graminicola, Mesobotrys* ≡ Lacellina graminicola
*graminicola* v. *andropogonis-sorghi, Sclerospora* ≡ Sclerospora andropogonis-sorghi
*grammocephalus, Polyporus* ≡ Favolus grammocephalus
*graminis, Cladochytrium* ≡ Physoderma graminis
graminis, Gaeumannomyces = Linocarpon cariceti
graminis, Ophiobolus = Linocarpon cariceti
*grevilleae, Amphichaeta* ≡ Cryptostictis grevilleae
grewiae, Phakopsora ≡ Dasturella grewiae
*grewiae, Uredo* ≡ Dasturella grewiae
*griseum, Trichothecium* ≡ Piricularia grisea
*guareicolum, Helminthosporium* ≡ Spiropes guareicola
gypseum, Trichophyton see T. mentagrophytes

*hansenii, Saccharomyces* ≡ Debaryomyces hansenii
*harknessii, Dendryphion* ≡ Septonema harknessii
*heterostemmae, Physalospora* ≡ Vestergrenia heterostemmae
*hispidula, Conoplea* ≡ Periconia hispidula
humuli, Sphaerotheca = S. macularis
humuli var. fuliginea, Sphaerotheca ≡ S. macularis var. fuliginea

*ignobilis, Uredo* ≡ Uromyces ignobilis
*inaequalis, Helminthosporium* ≡ Curvularia inaequalis
indica, Phyllachora ≡ Phyllachora uppalii
indicum, Colletotrichum see Vermicularia indica
inguinale, Epidermophyton see E. floccosum
*insulana, Cercosporina* ≡ Cercospora insulana
interseminata, Curvularia ≡ Dendryphion interseminatum
interseminata, Dendryphiella ≡ Dendryphion interseminatum
*interseminatum, Helminthosporium* ≡ Dendryphion interseminatum
interseminatum, Heterosporium ≡ Dendryphion interseminatum

*javanicus* var. *macrogynus, Allomyces* ≡ Allomyces macrogynus

*kobresiae, Cintractia* ≡ Sphacelotheca kobresiae

*lactea, Conferva* ≡ Leptomitus lacteus
*leve, Diorchidium* ≡ Puccinia levis
*longibrachiata, Botrytis* ≡ Botryosporium longibrachiatum
*luteum, Penicillium* ≡ Talaromyces luteus

*macrurum, Helminthosporium* ≡ Podoconis macrura
*macrospora, Sclerospora* ≡ Sclerophthora macrospora
*maculans, Spondylocladium* ≡ Curvularia maculans
*maculatum, Clasterosporium* ≡ Stigmina maculata
*malinverniana, Sphaerella* ≡ Mycosphaerella malinverniana
*manilensis, Ustilago* ≡ Sphacelotheca manilensis
mansoni, Cladosporium ≡ Dematium mansoni
*mansoni, Microsporum* ≡ Dematium mansoni
*medicum, Stereum* ≡ Lloydia medica
*meliolae, Spegazzinia* ≡ Carlosia meliolae
*micheliae, Phyllachorella* ≡ Vestergrenia micheliae
*microcephalum, Kentrosporium* ≡ Claviceps microcephala
minor, Olpidiopsis see O. fusiformis
molluginicola, Cystopus = Albugo molluginis
*monilioides, Isaria* ≡ Stysanus monilioides
musae, Macrophoma = Phyllostictina musarum
*musarum, Sphaeropsis* ≡ Phyllostictina musarum

*nabarroi, Monilia* ≡ Castellania nabarroi
nardi, Sphacelotheca ≡ Sorosporium nardi
*nardi, Ustilago* ≡ Sorosporium nardi
*nepalensis, Ustilago* ≡ Melanopsichium nepalensis
nidulans, Aspergillus ≡ Emericella nidulans
*nidulans, Sterigmatocystis* ≡ Emericella nidulans
*nivalis, Lanosa* ≡ Fusarium nivale
*niveum, Fusarium* ≡ Fusarium oxysporum f. niveum

*obscurans, Phoma* ≡ Dendrophoma obscurans
*obtusissima, Clavaria* ≡ Ramaria obtusissima
*occidentalis, Polystictus* ≡ Coriolus occidentalis
*ochroleucus, Polyporus* ≡ Fomitopsis ochroleuca
*omphaloides, Peziza* ≡ Pyronema omphaloides
*operta, Ustilago* ≡ Sphacelotheca operta
ornata, Spegazzinia = Spegazzinia tessarthra
*oryzae, Monotospora* ≡ Nigrospora oryzae
oryzae, Phaeosphaera ≡ Trematosphaerella oryzae
oxycanthae var. tridactyla, Podosphaera ≡ P. clandestina var. tridactyla

*palmivorum, Exosporium* ≡ Stigmina palmivora
paradoxa, Ceratostomella ≡ Certocystis paradoxa
paradoxa, Endoconidiophora ≡ Ceratocystis paradoxa
paradoxa, Thielaviopsis ≡ Ceratocystis paradoxa

*paratropicalis, Monilia* ≡ Castellania paratropicalis
paspali, Sorosporium = S. paspali-thumbergii
*paspali-thumbergii, Ustilago* ≡ Sorosporium paspali-thumbergii
patelii, Protomycopsis ≡ Protomycopsis phaseoli
*patouillardii, Polyporus* ≡ Inonotus patouillardii
peribebuyensis var. major, Cintractia see C. minor
pfeifferi, Ancylistes ≡ Ancylistes berdanii
phaseoli, Macrophomina, see Botryodiplodia phaseoli
*phaseoli, Synchytrium* ≡ Protomycopsis phaseoli
piaropi, Cercosporina ≡ Cercospora piaropii
pinoyi, Monilia see Candida albicans
poae, Tuburcinia see Urocystis agropyri
poae, Urocystis see Urocystis agropyri
*polymorpha, Monoblepharis* ≡ Gonapodya polymorpha
*porri, Macrosporium* ≡ Alternaria porri
*psidii, Pestalotia* ≡ Pestalotiopsis psidii
psilosis, Monilia = Candida albicans
psilosis, Syringospora see Candida albicans
*pterolobii, Physalospora* ≡ Phyllachora pterolobii
*pullulans, Dematium* ≡ Pullularia pullulans
*punjabensis, Macraea* ≡ Prathigada punjabensis
purpureum, Trichophyton see T. rubrum
pusio, Aphelaria ≡ Tremellodendropsis pusio
*pusio, Clavaria* ≡ Tremellodendropsis pusio

quadratum, Dictyoarthrinium = D. sacchari

*regnieri, Mucor* ≡ Lichtheimia regnieri
repens, Aspergillus ≡ Eurotium repens
*rhodophaea, Polyporus* ≡ Fomitopsis rhodophaea
*rhynchosiae, Stigmatea* ≡ Aphysa rhynchosiae
*ricini, Macrosporium* ≡ Alternaria ricini
*rugulosus, Aspergillus* ≡ Emericella rugulosa
rufula, Tryblidiella ≡ Rhytidhysterium rufulum
*rufulum, Hysterium* ≡ Rhytidhysterium rufulum

sacciolepidis, Sphacelotheca see Sphacelotheca manilensis
*schenkii, Rhizidium* ≡ Chytridium schenkii
schoenlini, Achorion ≡ Trichophyton schoenlini
*schoenlini, Oidium* ≡ Trichophyton schoenlini
*scleriae, Ustilago* ≡ Cintractia scleriae
*scopulosus, Polyporus* ≡ Amauroderma scopulosum
*scutellata, Lachnea* ≡ Patella scutellata
*sector, Boletus* ≡Polysticus sector
*senex, Polyporus* ≡ Phellinus senex
*simplex, Helicostilbe* ≡ Trochophora simplex
*simplicissimum, Penicillium* ≡ Spicaria simplicissimum
sorghi, Sclerospora ≡ Sclerospora andropogonis-sorghi
*sphaericum, Trichosporium* ≡ Nigrospora sphaerica
spinosa, Circinella see C. muscae
*subbotrytis, Clavaria* ≡ Ramaria subbotrytis

*tenuis, Hexagonia* ≡ Daedaleopsis tenuis
*terminaliae, Aecidium* ≡ Puccinia terminaliae
*terrestris, Spicularia* ≡ Pseudobotrytis terrestris
terrestris, Umbellula ≡ Pseudobotrytis terrestris
*terricola, Coniothyrium* ≡ Thielavia terricola
*tessarthrum, Sporidesmium* ≡ Spegazzinia tessarthra
tetramera, Helminthosporium see Curvularia tetramera & C. spicifera
tetraspora, Phyllachora ≡ Phyllachora travancorica
theae, Podoconis = Podoconis macrura
*trabeus, Agaricus* ≡ Lenzites trabea
*tracheiphilum, Fusarium* ≡ Fusarium oxysporum f. tracheiphilum
*tremae, Ragnhildiana* ≡ Cercospora tremae
*trichosanthes, Uredo* ≡ Kuehneola trichosanthes
*tricinctum, Selenosporium* ≡ Fusarium tricinctum
*tridactyla, Alphitomorpha* ≡ Podosphaera clandestina var. tridactyla
tridactyla, Podosphaera ≡ Podosphaera clandestina var. tridactyla
*trifolii, Brachysporium* ≡ Curvularia trifolii
*tucumanensis, Physalospora* ≡ Glomerella tucumanensis

vaccinii, Achorella ≡ Gibbera ramakrishnani
*variabilis, Monilia* ≡ Oospora variabilis
variecolor, Aspergillus ≡ Emericella variecolor
*versatilis, Trametes* ≡ Hirschioporus versatilis
*vignae, Uredo* ≡ Phakopsora vignae
vulgatum, Synchytrium see Synchytrium launeae
vulpinus, Polystictus see Polystictus cuticularis

*wortmannii, Penicillium* ≡ Talaromyces wortmannii

*zeylanica, Aseroe* ≡ Aseroe rubra var. ceylanica
*zonalis, Polyporus* ≡ Fomitopsis zonalis

## LIST OF HOSTS AND SUBSTRATA

*Acacia*
- Ravenelia acacicola
- R. acaciae-senegalae
- R. ajmerensis
- R. hansfordii
- R. hansfordii *var.* ferrugineae

*Acalypha*
- Cercosporella acalyphae
- Oidium acalyphae
- Torula herbarum
- Uredo acalyphae-fruticosae

*Acanthospermum*
- Oidium acanthospermi

*Achlya*
- Olpidiopsis achlyae
- O. fusiformis

*Acorus*
- Uromyces sparganiae *ssp.* asiaticus

*Adhatoda*
- Cercospora adhatodae

*Aecidium*
- Curvularia pallescens

*Agapanthus*
- Mycosphaerella agapanthi-umbellati

*Albizzia*
- Endodothella canarensis
- Fusarium solani *f.* albizziae
- Ravenelia clemensiae

*Alisma*
- Narasimhania alismatis
- Physoderma maculare

*Allium*
- Alternaria porri

*Alstonia*
- Colletotrichum alstoniae

*Alternanthera*
- Laestadia alternantherae

*Alysicarpus*
- Synchytrium cookii

*Amaranthus*
- Alternaria amaranthi

*Ampelocissus*
- Cercospora biharica
- Synchytrium ampelocissi

*Amphilophis*
- Puccinia amphilophidis
- Uromyces amphilophis-insculptae

*Anacardium*
- Atelosaccharomyces moachoi
- Endomyces anacardiae
- Parasaccharomyces giganteus
- Pythium spinosum

*Ananas*
- Spegazzinia sundara

*Anaphalis*
- Aecidium anaphalis-leptophyllae

*Andrographis*
- Cercospora andrographidis

*Andropogon*
- Ascochyta sorghi
- Tolyposporium andropogonis

*Aneilema*
- Physoderma aneilemae
- Physoderma commelinae

*Anisomeles*
- Cercospora anisomelicola

*Anopheles*
- Coelomomyces anophelesica
- C. indiana

*Anotis*
- Uromyces anotis-monospermae

*Antidesma*
- Cystopsora antidesmatis

*Apluda*
- Tilletia apludae

*Aquillaria*
- Epicoccum granulatum

*Arachis*
- Botryosporium longibrachiatum

*Areca*
- Exosporium arecae
- Lomaantha pooga
- Torula herbarum

*Aristida*
- Sorosporium consanguineum *var.* bullatum
- S. aristidae-cyananthae

*Artemesia*
- Periconia byssoides

*Arthraxon*
- Melanotaenium brachiariae *var.* arthraxonis
- Puccinia arthraxonis-ciliaris

*Cardiospermum*
  Cercospora cardiospermi
*Carex*
  Ustilago caricis-wallichianae
*Carica*
  Corynespora cassiicola
  Oidium indicum
*Carissa*
  Colletotrichum inamdarii
*Cassia*
  Cercospora cassiae-montanae
  Corynespora cassiicola
  Periconia byssoides
  Synchytrium cassiae
*Cassytha*
  Bitancourtia cassythae
*Castanea*
  Bagcheea castaneae
*Casuarina*
  Phoma casuarinae
*Celastrus*
  Cercospora celastricola
  Uredo celastri-paniculati
*Celosia*
  Cercospora celosiae
  Synchytrium celosiae
*Celtis*
  Helicoceras celtidis
  H. longisporum
  Stilbospora celtidis
*Centratherum*
  Cercospora chrysanthemi
*Chenopodium*
  Cercospora bertrandii
*Chloris*
  Puccinia chloridis-incompletae
  Ustilago deserticola
*Chloroxylon*
  Cercospora chloroxyli
*Chorysandra*
  Phakopsora chorysandrae
*Chrysanthemum*
  Phoma chrysanthemicola
*Cicer*
  Fusarium orthoceras
  Uredo ciceris-arietini
*Cipadessa*
  Cercospora cipadessae
*Cissampelos*
  Synchytrium cissampelum
*Citrullus*
  Fusarium oxysporum *f.* niveum
*Citrus*
  Capnodium citri
  Gloeosporium limetticolum
  G. spegazzinii
  Melanomma citricola
  Meliola butleri
  Penicillium expansum
  P. italicum
  Phomopsis citri
  Septobasidium pseudopedicellatum
  Stysanus monilioides
  Uredo citri
*Clerodendron*
  Cercospora volkmeriae
  Physalospora clerodendri
*Clitoria*
  Periconia byssoides
  P. clitoriae
*Closterium*
  Ancylistes berdanii
  A. closterii
*Coccinia*
  Synchytrium wurthii
*Cocos*
  Actiniceps cocos
  Curvularia palmarum
  Dictyoarthrinium sacchari
  Gliocladium roseum
  Lomachashaka kera
  Periconia hispidula
  Polydesmus indicus
  Pseudocamptoum fasciculatum
  Torula herbarum
*?Cocos*
  Curvularia palmarum
*Coelogyne*
  Phomopsis orchidophila
  Physalospora camptospora
  Septoria selenophomoides
*Commelina*
  Kordyana celebensis
  Physoderma commelinae
*Commiphora*
  Ascochyta commiphorae
*Conifers*
  Fomes roseus
  Poria rixosa
*Convolvulus*
  Macrophoma convolvulacearum
*Conyza*
  Cercospora nilghirensis

P. hispidula
Prathoda saparva
Pseudobotrytis terrestris
Torula herbarum

*Dead wood*
Antromycopsis broussonetiae *v.* minor
Coprinus disseminatus
Daedalea subsulcata
Excipularia narsapurensis
Guepinia peziza
Periconia narsapurensis
Ramaria stricta *var.* concolor

*Delonix*
Microstroma delonicis
Septoria delonicis

*Derris*
Homostegia derridis

*Desmodium*
Phakopsora mangalorica

*Dialeurodes*
Aschersonia papillata

*Dichanthium*
Curvularia andropogonis
Physoderma dichanthicolum
Sclerospora dichanthicola

*Digitaria*
Physoderma digitariae
Puccinia levis
Tilletia digitaricola

*Dimeria*
Phyllachora uppalii

*Dolichos*
Phyllachora dolichogena

*Dosooti*
Paecilomyces varioti

*Dracaena*
Colletotrichum dracaenicola

*Duchesne*
Synchytrium wurthii

*Dung*
Ascobolus immersus
A. indicus
Coprinus stellatus
Peziza vesiculosa

*Echinochloa*
Claviceps microcephala
Physoderma echinochloae

*Eichhornia*
Cercospora piaropii

*Elaeagnus*
Endophyllum elaeagni-latifoliae

*Elaeocharis*
Cercospora caricis
Sphacelotheca elaeocharidis

*Elatostemma*
Mycosphaerella elatostemmae

*Elephantopus*
Uredo elephantopodis

*Eleusine*
Piricularia grisea
Sclerophthora macrospora

*Emelia*
Synchytrium emeliae
Uredo emeliae-scabrae

*Eragrostis*
Basidiophora butleri
Sorosporium turneri
Tilletia transvaalensis

*Eremopogon*
Uromyces klygnii

*Erianthus*
Uredo ravennae

*Eriochloa*
Tilletia pulcherrima *var.* brachiariae

*Erythroxylon*
Cercospora erythroxylonis

*Eublemma*
Cephalosporium indicum

*Eugenia*
Cercospora eugeniae

*Eupatorium*
Cercospora eupatoricola

*Euphorbiaceae*
Torula herbarum

*Evolvulus*
Puccinia desertorum

*Fagopyrum*
Cercospora fagopyri

*Fibre*
Chaetomium funiculosum
Paecilomyces varioti
Penicillium brefeldianum
P. implicatum
P. purpurogenum
P. roseo-purpureum
P. variabile
Stemphylium consortiale
Talaromyces vermiculatus
Verticillium glaucum

*Ficus*
Cercospora fici
Exosporium fici
Stachybotrys pulchra
Sphaceloma fici
*Fimbristylis*
Cintractia clintonii
Phyllachora cyperi
Zundelula fimbristylidis
*Flemingia*
Phyllachora flemingiae
*Fleurya*
Cercospora fleuryae
*Fragaria*
Dendrophoma obscurans
Fabraea earliana
Marssonina fragariae

*Galactia*
Cercospora galactiae
*"Garden lilies"*
Sclerotium delphinii
*Glycine*
Cercospora diazu
*Glycosmis*
Macrophoma glycosmidis
*Glyricidia*
Cercospora glyricidiae
*Garnotia*
Puccinia garnotii
*Glochidion*
Arthuria glochidionis
Macrophoma glochidii
*Gmelina*
Poria rhizomorpha
*Gordonia*
Macrophoma gordoniae
*Gossypium*
Phakopsora desmium
Rhizopus nodosus
*Grass*
Periconia paludosa
Spegazzinia tessarthra
Tharoopama trina
Ustilago striiformis
*Grewia*
Cercospora grewiae
C. grewiicola
Dasturella grewiae
Puccinia tiliaefolia
Ramularia grewiae
Stilbospora grewiae

*Gymnema*
Aecidium gymnematis
Ramularia gymnematis
*Gymnopetalum*
Puccinia gymnopetali-wightiae
*Gynandropsis*
Torula herbarum

*Haematoxylon*
Cercospora haematoxyli
*Haplocerambyx*
Beauveria bassiana
*Hedera*
Phyllosticta hederae
*Helichrysum*
Puccinia kalchbrenneri
*Hesperthusa*
Sphaceloma hesperthusae
*Heteropogon*
Sphacelotheca mcalpiniae
*Hevea*
Gloeosporium albo-rubrum
*Hibiscus*
Anthostomella hibisci
Phoma sabdariffae
Phyllachora minuta
Synchytrium hibisci
*Hopea*
Phyllachora canarensis
*Hugonia*
Phyllachora hugoniae
*Humus*
Ramaria flaccida
R. stricta *var.* concolor
*Hydrolea*
Cercospora hydroleae

*Ilex*
Meliola falcatiseta *var.* khassiensis
*Imperata*
Cercospora imperatae
*Indigofera*
Cercosporella endecaphyllae
Synchytrium crustatum
*Insects*
Aschersonia papillata
*Ipomoea*
Albugo evolvuli *var.* mysorensis
A. ipomoeae-aquaticae
*Isachne*
Puccinia kunthiana

*Iva*
Puccinia intermixta
*Ixora*
Zygosporium oscheoides

*Jasminum*
Cercospora jasminicola
Phaeodothis cordifoliae
Physalospora jasmini
Torula herbarum
*Justicia*
Cercospora acanthacearum
*Jute cloth*
Aspergillus proliferans
Paecilomyces varioti
Penicillium citrinum
P. variabile
P. verruculosum
Talaromyces vermiculatus
*Jute fibre*
Aspergillus atropurpureus
Chaetomium brasiliense
Paecilomyces varioti
Penicillium adametzii
P. cyaneum
P. tardum
Talaromyces luteus

*Kirganellia*
Cercospora kirganelliae
*Knoxia*
Cercospora knoxiae
*Kydia*
Cercospora althaeina

*Lagascea*
Oidium lagasceae
*Lagenaria*
Diplodia natalensis
Synchytrium wurthii
*Lagerstroemia*
Marasmius campanella
Trametes incerta
*Lantana*
Amphisphaeria lantanae
Dictyosporium prolificum
*Launea*
Synchytrium launeae
*Leather*
Lichtheimia regnieri
*Leea*
Aecidium leeae
*Leguminosae*
Helicomina indica
*Lens*
Fusarium orthoceras *var.* lentis
*Lepidagathis*
Cercospora lepidagathidis
*Leptochloa*
Ustilago ornata
*Leucas*
Cercospora leucadis
*Lippia*
Cercospora lippiae
*Litsaea*
Helminthosporium litsae
*Lobelia*
Cercospora effusa
*Lonicera*
Fomes sanfordii
Hypoderma leschnaultii
*Lophopetalum*
Aecidium lophopetali
*Luffa*
Synchytrium wurthii
*Lycopersicon*
Cercospora diffusa
C. fuligena
Fusarium equiseti *var.* bullatum
Septoria lycopersici

*Macaranga*
Englerula macarangae
*Malva*
Puccinia malvacearum
*Man*
Achorion actoni
A. indicum
Candida albicans
Castellania bronchialis
C. nabarroi
C. paratropicalis
Dematium mansoni
Epidermophyton floccosum
Favotrichophyton discoides
Glenospora semoni
Indiella mansoni
Malassezia tropica
Microsporum audouini
Trichophyton concentricum
T. ferrugineum
T. mentagrophytes
T. rubrum
T. schoenlini

T. tonsurans
T. violaceum
*Mangifera*
Actinodochium jenkinsii
Lentinus fasciatus
*Manilkara*
Septoria hexandrae
*Mariscus*
Cercospora ugandensis
*Medicago*
Cercospora medicaginis
*Melilotus*
Synchytrium meliloti
*Meliola*
Arthrobotryum melanoplaca
Calloriopsis gelatinosa
Carlosia meliolae
Dimerium piceum
Eriomycopsis meliolae
E. bosquieae
Helminthosporium capense
H. dorycarpum
Isaria meliolae
Spiropes guareicola
*Meliosma*
Aecidium meliosmae-wightiae
Mycosphaerella meliosmae
*Melocanna*
Poria rhizomorpha
*Melochia*
Cercospora corchorifolia
*Merremia*
Albugo evolvuli *var.* merremiae
A. pratapi
Cercospora merremiae
*Micranthus*
Synchytrium micranthum
*Millingtonia*
Synchytrium millingtonicolum
*Mimosa*
Ramularia evernia
R. mimosae
*Momordica*
Synchytrium wurthii
*Morinda*
Gloeosporium morindae
Macrophoma morindae
*Moringa*
Cercospora moringae
*Morus*
Clasterosporium mori
*Murraya*
Meliola tenella
*Musa*
Curvularia maculans
Stachybotrys atra
Torula herbarum
*Myristica*
Diplodia natalensis

*Nelumbium*
Physoderma nelumbi
*Nicotiana*
Fusarium solani *f.* nicotianae
*Nothopegia*
Asteroconium nothopegiae
Cercospora nothopegiae
*Nymphaea*
Cercospora californiensis
Entyloma nymphaeae *var.* macrospora

*Ochna*
Phyllachora kambakkamensis
*Odina*
Beltraniella indica
*Oenothera*
Synchytrium brownii
*Oldenlandia*
Synchytrium oldenlandiae
*Operculina*
Puccinia operculinae
*Oplismenus*
Ustilaginoidea oplismeni
*Oroxylon*
Synchytrium oroxyli
*Oryza*
Alternaria oryzae
Aspergilus versicolor
Curvularia geniculata
C. pallescens
C. spicifera
Fusarium scirpi *var.* longipes
Koorchaloma madreeya
Leptosphaeria culmifraga
L. oryzina
L. salvinii
Linocarpon cariceti
Melanospora zamiae
Nigrospora oryzae
Penicillium purpurogenum
Periconia minutissima
Talaromyces luteus

*Osbeckia*
Trabutia osbeckiae

*Palm*
Periconia hispidula
*Panicum*
Petersenia panacicola
Tilletia biharica
T. narasimhanii
T. panici-humilis
T. verrucosa
*Paper*
Paecilomyces varioti
Stachybotrys atra
*Parmelia*
Phyllosticta galligena
*Paspalum*
Puccinia substriata
Sorosporium paspali *var.* verrucosum
*Passiflora*
Schiffnerula malabarensis
*Pavetta*
Hemileia pavetticola
Kulkarniella pavettae
*Pavonia*
Aecidium pavoniae-odoratae
*Pennisetum*
Beniowskia graminis
*Peristrophe*
Cercospora peristrophes
*Perotis*
Tilletia perotidis
*Phaseolus*
Isariopsis griseola
Phakopsora vignae
Protomycopsis phaseoli
Synchytrium phaseoli-radiati
*Phoebe*
Microcyclus phoebes
*Phoenix*
Chloridium indicum
Periconia tirupatiensis
Podoconis macrura
Pseudocamptoum fasciculatum
Septonema harknessii
*Photinia*
Annellophora indica
*Phyllachora*
Annajenkinsia fungicola
*Phyllanthus*
Ravenelia coimbatorica
Synchytrium phyllanthi
*Picea*
Merulius lacrymans
*Pinus*
Polyporus betulinus
*Picea*
Polyporus palustris
*Pisum*
Fusarium oxysporum *f.* pisi
*Plant debris*
Botryosporium longibrachiatum
Ramaria flaccida
*Plectronia*
Meliola plectroniae
*Pleiospermum*
Sphaceloma hesperthusae
*Plumeria*
Cercospora plumeriae
*Pogonatherum*
Puccinia pogonatheri
*Polyalthia*
Phyllachora travancorica
*Pongamia*
Polyporus cinerescens
*Pothos*
Colletotrichum cylindricum
*Prunus*
Podosphaera clandestina *var.* tridactyla
*Psidium*
Fusarium oxysporum *f.* psidii
Gloeosporium psidii
Glomerella psidii
Pestalotiopsis psidii
*Psychotria*
Aecidium iquitosense
*Pteris*
Aulographopsis indica
*Pterolobium*
Titaeospora pterolobii
*Pyrenacantha*
Macrophoma pyrenacanthae
Physalospora pyrenacanthae
*Pyrilla*
Hirsutella abietina
*Pyrus*
Botryosphaeria ribis
Penicillium expansum

*Quercus*
Fomes leucophaeus
Hymenochaete rubiginosa

H. tabacina
Inonotus nothofagi
Lenzites pallisoti
Merulius tremellosus
Peniophora filamentosa
Polyporus consors
Pseudoplectania kumaonensis
Ramaria stricta *var.* concolor

*Quisqualis*
Sapucchaka madreeya

*Ranunculus*
Urocystis anemones

*Rejoua*
Cercospora rejouae

*Rhamnus*
Hypodermella rhamni

*Rhinacanthus*
Uredo rhinacanthi

*?Rhododendron*
Patella scutellata

*Rhus*
Fomes ostricoloris

*Rhynchosia*
Aphysa rhynchosiae
Cercospora rhynchosiae-minimae
Synchytrium rhynchosiae

*Rhynchospora*
Cintractia scleriae

*Riccia*
Patellaria ricciophila

*Ricinus*
Alternaria ricinae
Cephalosporium curtipes

*Rosa*
Cercospora puderii
Pestalotia seiridioides

*Rosaceae*
Phragmidium malvacearum

*Rubiaceae*
Torula herbarum

*Rubus*
Guignardia rugosa

*Rungia*
Plasmopara wildemanniana *var.* macrospora

*Saccharum*
Cercospora kopkii
Lacellinopsis sacchari
Sphacelotheca consimilis
S. manilensis
S. schweinfurtiana *var.* minor

*Salacia*
Meliola salaciae
Phyllachora amphididyma

*Salvadora*
Polyclypeolum salvadorae

*Sapindus*
Macrophoma sapindi

*Sarcostemma*
Julella sarcostemmatis
Massarina sarcostemmatis

*Scirpus*
Curvularia indica
C. maculans
C. trifolii
C. uncinata

*Scolopia*
Phyllachora scolopiae

*Scoparia*
Cercospora scopariae

*Sesamum*
Alternaria sesamicola
Synchytrium sesami

*Setaria*
Physoderma setaricola
Sorosporium setaricolum
Tilletia makutensis
T. setaricola

*Shorea*
Daedalea schomburgkii
Fomes ribis
F. roseus
Grandinia farinacea
Hymenochaete rubiginosa
Hypoxylon annulatum
Lentinus fasciatus
Lenzites flaccida
Macrophoma shoreae
Marasmius cupressiformis
M. gordipes
Polystictus sector
P. venulosus
Trametes corrugata
T. incerta

*Sida*
Coleosporium sidae
Synchytrium maculans

*Soil*
Absidia butleri
A. glauca
A. heterospora
A. spinosa

Acrostalagmus cinnabarinus
Allomyces macrogynus
Alternaria humicola
Aspergillus alliaceus
A. awamori
A. clavatus
A. flavipes
A. giganteus
A. glaucus
A. niveus
A. proliferans
A. sclerotiorum
A. violaceo-fuscus
A. wentii
Cephalosporium roseo-griseum
Chaetomium bostrychodes
C. trilaterale
Cladosporium cladosporioides
C. epiphyllum
Cunninghanella bertholettiae
Curvularia maculans
C. pallescens
Fusarium dimerum
F. nivale
F. orthoceras
F. scirpi var. caudatum
F. sporotrichioides
F. tricinctum
Gliocladiopsis sagariensis
Gliocladium deliquescens
G. roseum
Helminthosporium microsorum
Macrosporium commune
Melanospora brevirostrata
Monocillium indicum
Mucor luteus
M. mucedo
Nigrospora sphaerica
Oedocephalum coprophilum
Oospora variabilis
Paecilomyces fusisporus
P. varioti
Penicillium brefeldianum
P. chrysogenum
P. frequentans
P. funiculosum
P. implicatum
P. lilacinum
P. nigricans
P. rubrum
P. sanguifluus
P. simplicissimum
P. steckii
P. terrestre
P. variabile
P. viride-varians
Phoma hibernica
Pythium mamillatum
Rhizopus nigricans *var.* minutus
R. nodosus
R. oryzae
Robillarda depazeoides
Saksenaea vasiformis
Scopulariopsis brevicaulis
Spondylocladium australe
Sporotrichum epigaeum *var.* terrestre
Starkeyomyces koorchalomoides
Talaromyces luteus
T. vermiculatus
Thielavia basicola
T. terricola
Trichosporium fuscum
Trichothecium roseum

*"Soil"*
Agaricus arvensis
A. pratensis
Ascobolus magnificus
Boudiera seaveri
Coprinus atramentarius
Morchella vulgaris
Patella scutellata
Patellaria ricciophila
Peziza badia
Pseudoplectania kumaonensis
Pyronema omphaloides
Russula lepida
Ramaria subbotrytis
R. obtusissima
R. fumigata *var.* gigantea
Tremellodendropsis pusio

*Solanum*
Botryodiplodia phaseoli
Cercospora solanacea
C. solani-tuberosi
C. trichophila
C. venezuelae *var.* indica
Fusarium equiseti var. bullatum
Synchytrium akshaiberi
S. endobioticum
S. melongenae

*Sorghum*
Colletotrichum lineola

*Spilanthes*
Aecidium spilanthes

Endophyllum spilanthes

*Spirogyra*
Chytridium legenaria
C. schenkii
Lagenidium rabenhorstii
Myzocytium proliferum

*Sporobolus*
Tolyposporella sporoboli

*Spruce*
Fomes robustus

*Statice*
Cercospora insulana

*Straw*
Chaetomium rufum
Periconia hispidula
Volutina concentrica

*Strobilanthus*
Aecidium cuspidatum

*Strychnos*
Meliola stenospora

*Symplocos*
Homostegia symploci

*Syzygium*
Didymosphaeria jambolana
Lasiosphaeria caryophylli
Neobarclaya congesta

*Tabernaemontana*
Cercospora tabernaemontanae

*Tamarindus*
Candida tamarindi

*Tan liquor*
Kloeckera apiculata
Penicillium camemberti
P. claviforme
P. granulatum

*Taraktogenos*
Poria rhizomorpha

*Tephrosia*
Cercospora hardwarensis

*Terminalia*
Cercospora catappae
Puccinia terminaliae
Sphaceloma terminaliae
Uredo terminaliae

*Thea*
Aglaospora aculeata
Hymenochaete tabacina
Nectria ochroleuca
Leptothyrium theae
Macrophoma theicola
Septobasidium bogoriense

*Themeda*
Tilletia themedae-anatherae
T. themedicola

*Thysanolaena*
Arthrobotryum coonoorense

*Tinospora*
Ramularia tinosporae

*Toddalia*
Macrophoma toddaliae

*Trapa*
Cercospora trapae

*Trees*
Fomes dependens
Polyporus monosporus

*Trema*
Cercospora tremae

*Trichodesma*
Cercospora trichodesmae
Synchytrium trichodesmatis

*Trichosanthes*
Kuehneola trichosanthes
Synchytrium wurthii

*Tridax*
Cercospora tridacis-procumbentis

*Tripogon*
Uromyces tripogonicola

*Triticum*
Cochliobolus tritici
Helminthosporium nodulosum *var.* tritici
Septoria nodorum

*Urginea*
Aecidium urgineae

*Vanda*
Phomopsis orchidophila

*Vangueria*
Biharia vangueriae

*Ventilago*
Phyllachora ventilaginis

*Vernonia*
Plasmopara vernoniae-chinensis
Puccinia pectiniformis
Synchytrium vernoniae

*Veronia*
Cercospora occulata var. indica

*Veronica*
Schroeteria delastrina

*Viburnum*
Hypoderma viburni

*Vigna*
Fusarium oxysporum *f.* tracheiphilum
*Vitis*
Guignardia bidwellii
Synchytrium viticola

*Water*
Absidia glauca
Achlya klebsiana
Blastocladia globosa
B. ramosa
B. sparrowii
Candida guilliermondii
C. melibiosi
C. tropicalis
Cryptococcus laurentii
Debaryomyces hansenii
D. kloeckeri
D. nicotianae
D. subglobosus
Dicoccum asperum
Discomycetella aquatica
Geotrichum candidum
Gonapodya polymorpha
G. prolifera
Hanseniaspora valbyensis
Leptomitus lacteus
Margaritispora aquatica
Monotospora brevis
M. daleae
Piricularia aquatica
Rhodotorula minuta
R. mucilaginosa
R. pallida
Saccharomyces fructuum
S. rosei
S. steineri
Saprolegnia ferax
Torulopsis candida
T. dattila
T. hamata
T. glabrata
*Wendlandia*
Cercospora wendlandiae
*Wood*
Auricularia polytricha
A. rosea
Cephaliophora irregularis
Hydnum imbricatum
Irpex maximus
Lenzites trabea
Merulius lacrymans
Patella scutellata
Pleurotus belangeri
Polyporus palustris
Poria metamorphosa
Psathyrella disseminata
Torula herbarum
Trametes suaveolens
*Woodfordia*
Cercospora sydowiana

*Zeuzera*
Hirsutella nodulosa
*Zizania*
Cercospora zizaniae
*Zizyphus*
Cercospora jujubae
*Zornia*
Synchytrium zorniae

*Substratum not known*
Aseroe rubra *var.* ceylanica
Gliocladium deliquescens
Heterochaete mussoriensis
Hexagonia pulchella
Polyporus similis
Polystictus cuticularis
Ravenelia sayeedii
Trametes cinnabarinus
Ustilago bullata
U. neglecta

# SYSTEMATIC ARRANGEMENT OF GENERA

## PHYCOMYCETES

Absidia
Achlya
Albugo
Allomyces
Ancylistes
Basidiophora
Blastocladia
Chytridium
Circinella
Coelomomyces
Cunninghamella
Entomophthora
Gonapodya
Lagenidium
Leptomitus
Lichtheimia
Mucor
Myzocytium
Olpidiopsis
Petersenia
Physoderma
Phytophthora
Plasmopara
Pythium
Rhizopus
Saksenaea
Saprolegnia
Sapromyces
Sclerospora
Sclerophthora
Syncephalis
Synchytrium

## ASCOMYCETES

Aglaospora
Amazonia
Amphisphaeria
Annajenkinsia
Anthostomella
Aphysa
Apiocrea
Ascobolus
Atelosaccharomyces
Bagcheea
Balansia
Bitancourtia
Botryosphaeria
Boudiera
Calloriopsis
Capnodium
Ceratocystis
Ceratosphaeria
Chaetomium
Claviceps
Clypeolella
Cochliobolus
Debaryomyces
Didymosphaeria
Dimerium
Discomycetella
Eidamella
Elsinoe
Emericella
Endodothella
Endomyces
Englerula
Erysiphe
Eurotium
Fabraea
Gibbera
Glomerella
Guignardia
Hanseniaspora
Homostegia
Hypoderma
Hypodermella
Hypoxylon
Julella
Laestadia
Lasiosphaeria
Leptosphaeria
Linocarpon
Massarina
Melanomma
Melanopsamma
Melanospora

## ASCOMYCETES (Contd.)

Meliola
Metasphaeria
Microcyclus
Morchella
Mycosphaerella
Nectria
Patella
Patellaria
Peziza
Phaeodothis
Phaeodimeriella
Phomatospora
Phyllachora
Phyllactinia
Physalospora
Podosphaera
Polyclypeolum
Protomycopsis
Pseudoplectania
Pyronema
Rhytidhysterium
Saccharomyces
Sapucchaka
Sartorya
Schiffnerula
Sphaerostilbe
Sphaerotheca
Talaromyces
Taphrina
Thielavia
Trabutia
Trematosphaerella
Uncinula
Vestergrenia

## FUNGI IMPERFECTI

### SPHAEROPSIDALES

Anthasthoopa
Aschersonia
Ascochyta
Botryodiplodia
Dendrophoma
Didymochora
Diplodia
Macrophoma
Petrakomyces
Phoma
Phomopsis
Phyllosticta
Phyllostictina
Plagionema
Robillarda
Septoria

### MELANCONIALES

Asteroconium
Colletotrichum
Cryptostictis
Gloeosporium
Marssonina
Microstroma
Neobarclaya
Pestalotia
Pestalotiopsis
Ramulispora
Rostrospora
Sphaceloma
Stilbospora
Titaeospora
Vermicularia

### MONILIALES

Achorion
Acrostalagmus
Actiniceps
Actinodochium
Alternaria
Annellophora
Antromycopsis
Arthrinium
Arthrobotryum
Aspergillus
Beauveria
Beltrania

MONILIALES (Contd.)

Beltraniella
Beniowskia
Biharia
Blodgettia
Botryosporium
Camptomeris
Candida
Carlosia
Castellania
Cephaliophora
Cephalosporium
Cercospora
Cercosporella
Cercosporina
Chloridium
Cladosporium
Clasterosporium
Corynespora
Cryptococcus
Curvularia
Dematium
Dendryphion
Dicoccum
Dictyoarthrinium
Dictyosporium
Epicoccum
Epidermophyton
Eriomycopsis
Excipularia
Exosporium
Favotrichophyton
Fusarium
Geotrichum
Gliocladiopsis
Gliocladium
Helicoceras
Helicomina
Helminthosporium
Hirsutella
Indiella
Isaria
Isariopsis
Kloeckera
Koorchaloma
Lacellina
Lacellinopsis
Lomaantha
Lomachashaka
Macrosporium
Malassezia
Margaritispora
Memnoniella
Microsporum
Monilia
Monocillium
Monotospora
Nigrospora
Oedocephalum
Oidium
Oospora
Paathramaya
Paecilomyces
Parasaccharomyces
Penicillium
Phaeotrichoconis
Piricularia
Podoconis
Polydesmus
Prathigada
Prathoda
Pseudobotrytis
Pseudocamptoum
Pullularia
Ramularia
Rhodotorula
Scopulariopsis
Septonema
Spegazzinia
Spiropes
Spondylocladium
Sporotrichum
Stachybotrys
Starkeyomyces
Stemphylium
Stigmina
Stemphylium
Tharoopama
Torula
Torulopsis
Trichophyton
Trichosporium
Trichothecium
Trochophora
Ustilaginoidea
Varicosporium
Verticillium
Volutina
Wiesneriomyces
Zygosporium

## BASIDIOMYCETES

### AURICULARIALES

Auricularia
Guepinia

### TREMELLALES

Glenospora
Heterochaete
Septobasidium

### USTILAGINALES

Cintractia
Entyloma
Farysia
Melanopsichium
Melanotaenium
Narasimhania
Schroeteria
Sorosporium
Sphacelotheca
Thecaphora
Tilletia
Tolyposporella
Tolyposporium
Urocystis
Ustilago
Zudelula

### UREDINALES

Aecidium
Angiopsora
Arthuria
Coleosporium
Cystopsora
Dasturella
Endophyllum
Hemileia
Kuehneola
Kulkarniella
Phakopsora
Phragmidium
Puccinia
Pucciniostele
Ravenelia
Uredo
Uromyces

### AGARICALES

Agaricus
Amauroderma
Coprinus
Coriolus
Cryptoderma
Daedalea
Daedaleopsis
Favolus
Fomes
Fomitopsis
Grandinia
Hexagonia
Hirschioporus
Hydnum
Inonotus
Irpex
Kordyana
Lentinus
Lenzites
Marasmius
Merulius
Peniophora
Phellinus
Pleurotus
Polyporus
Polystictus
Poria
Ramaria
Russula
Stereofomes
Trametes
Tremellodendropsis

## MYCELIA STERILIA

Sclerotium

## INCERTAE SEDIS

Aulographopsis

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